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ABSTRACT

This curriculum guide provides materials for a course of instruction designed for training concrete masons who will make their careers in construction. It contains 4 sections and 18 instructional units in a standard format. Eight basic components that form a unit of instruction are performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. Depending on specific objectives, transparency masters, supplements, assignment sheets, or job sheets may not be included. The five units in the introduction section concern the free enterprise system, America's infrastructure, industry orientation, history of cement industry, and safety and basic first aid. Section 2, which supplies related information, contains units on basic math, measuring, basic plan reading, and estimating. Section 3, which concerns fundamentals of concrete construction, has 4 units on concrete ingredients, designing concrete mixes, admixtures, and specifications and testing. The five units in the final section focus on forming tools, hand tools, power tools, miscellaneous equipment, and leveling instruments. (YLB)

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OKLAHOMA STATE BOARD OF VOCATIONAL AND TECHNICAL EDUCATION ·

fundamentals of concrete and cement masonry

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Fundamentals of Concrete and Cement Masonry

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FUNDAMENTALS OF CONCRETE AND CEMENT MASONRY

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FOREWORD

In 1975, The Associated General Contractors of America (AGC) met with representatives of the Oklahoma Curriculum and Instructional Materials Center (CIMC) to discuss the possibilities of developing, as a cooperative project, a course of instruction designed for training concrete masons who will make their careers in construction.

This publication is the result of those original discussions and the product of close coordination among general contractors, concrete masons, people who actually work in construction, and vocational educators. This manual represents a conscious effort to meld the practical experience of personnel in the construction industry with the best instructional methods of those in the field of vocational education.

The trainers of skilled construction workers are faced with the challenge of providing thorough and modern training to the backbone of the construction industry, its work force. The purpose of this manual is to assist instructors in providing a high-caliber instructional program. In 1986, AGC and CIMC decided that there was a need to update this manual in order to keep up with the ever-changing materials, skills, techniques, and demands of the profession. Therefore, we have revised this manual with these changes in mind. Although the format reflects a systematic approach to instructional materials development and the latest in educational technology innovations, the information in *Fundamentals of Concrete and Cement Masonry* should be adapted and modified to coincide with local conditions. To make the training process complete, the materials should be coupled with the instructor's own methods, experience, and additional materials.

Roy Peters, Jr., Director
Oklahoma State Department of
Vocational and Technical Education

H. Pratt Farnsworth, Jr., Chairman
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of America

PREFACE

For many years contractors and those responsible for training concrete masons felt the need for instructional materials to be used in training. In 1975, The Associated General Contractors of America (AGC), with the cooperation and support of the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center (CIMC), accepted the challenge and produced a manual for use in training concrete masons in those areas in which they are expected to be proficient. In 1986, AGC and the CIMC decided that there was a need to update this manual in order to keep up with the ever-changing materials, skills, and demands of the profession.

Concrete mason instructors are faced with the challenge of providing students with the skill and related information necessary to meet the demands of a changing profession. Competition for jobs is greater than ever. Therefore, the concrete mason must be better trained and better equipped to find and retain meaningful employment. This is why AGC and CIMC felt a need to revise and update this manual.

Instructional material in this manual is written in terms of student performance, using measurable behavioral objectives. This is an innovative approach to teaching that accents and augments the teaching/learning process. Criterion-referenced evaluation instruments provide for a uniform measurement of student progress.

The purpose of this manual is to assist concrete mason instructors in providing instruction throughout the industry. This publication should be supplemented by each instructor's methods and materials. Any information in this manual that does not concur with the instructor's course of study should be modified to meet personal needs.

ACKNOWLEDGEMENTS

Appreciation is expressed to the many individuals who contributed their time, talents, and knowledge in the preparation of the revision of this manual.

Thank you to the following *ad hoc* committee members, staff representatives of The Associated General Contractors, and to the staff of the Oklahoma State Department of Vocational and Technical Education.

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Special appreciation is extended to Mike Clark, Bob Florey, Art Moffitt, and Robert Holton, general secretary treasurer, Operative Plasters and Cement Masons International Association, who gave much of their time, expertise, and technical support. Without their combined efforts, this publication would not have been possible.

I would also like to thank the following people for their contributions to this publication. Al Maguire, vice president, Concrete Systems, Nelson and Sloan Transit-Mixed Concrete, Chula Vista, California; Burrell Griffin, vice president, Standard Testing and Engineering, Oklahoma City, Oklahoma; Jack Nicolls, manager of technical services, Northern California Region, Kaiser Cement Corporation, Freemonte, California; Richard O. Richardson, manager, Oklahoma Region, Master Builders, Inc., Tulsa, Oklahoma; A.L. Paylor, sales representative, Master Builders, Inc., Blanchard, Oklahoma; Ron Lightfoot, Perkins, Oklahoma; and Scott Williams, Stillwater, Oklahoma.

USE OF THIS PUBLICATION

Instructional Units

Fundamentals of Concrete and Cement Masonry contains four sections and eighteen instructional units. A standard format was established in 1970 for development of instructional materials for all Oklahoma vocational teachers. This format includes eight basic components that form a unit of instruction: performance objectives, suggested activities for the teacher, information sheets, assignment sheets, job sheets, transparency masters and supplements, tests, and answers to tests and assignment sheets. Depending on the specific objectives, there may or may not be transparency masters, supplements, assignment sheets, or job sheets included in the unit of instruction.

All of the unit components "zero in" on measurable and observable learning outcomes. Teachers are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

Units of instruction are designed for use in more than one lesson or class period of instruction. Careful study of each unit of instruction by the teacher will help him or her determine the following

- Amount of material that can be covered in each class period
- Skills that must be demonstrated
  - Supplies and equipment needed
  - Amount of practice needed
  - Amount of class time needed for demonstrations
- Supplementary materials, such as pamphlets and filmstrips, that must be ordered
- Resource people to contact

Performance Objectives (white pages)

Each unit of instruction is based on the performance needed for successful employment in an occupational area. Performance objectives are stated in two forms: unit objectives, stating the subject matter to be covered in a unit of instruction; and specific objectives, stating the performance necessary to reach the unit objective. Since the objectives of the unit provide direction for the teaching/learning process, it is important that teachers and students have a common understanding of the intent of the objectives.

The objective sheet should be given to students and referred to throughout the teaching/learning process. This will help answer any questions concerning performance requirements for each instructional unit. The objectives can also help determine teaching strategies and instructional methods. Prepare for each unit by deciding how each objective can best be taught.

The objective sheet may also be used as a quick pretest to determine students' prior knowledge and to determine whether further study or activities are necessary. Teachers should feel free to modify, delete, or add objectives in order to meet the needs of the students and community. When changes in objectives are made, the teacher should remember to supply the needed information, assignment and/or job sheets, and criterion test items.

Suggested Activities (pink pages)

Suggested activities are included only in teacher materials. The suggested activities pages include an outline of the unit contents and an instructor's guide designed to assist teachers in planning their presentation of the unit. The instructor's guide provides suggestions for delivery and/or presentation during the instructional process. Read the suggested activities before teaching the units so that supplemental materials can be obtained, audiovisual materials prepared, and outside resources contacted. Duties of the teacher will vary according to the particular unit.

The references that are listed in the suggested activities are ones used in the development of each unit. They may be used by the teacher to supplement her or his knowledge of the subject area or to help students with particular interests or occupational objectives in the area covered.

All references in this publication were known to exist at the time of the writing of this publication. AGC/CIMC assumes no responsibility to provide these materials and cannot ensure the availability of these materials as individual vendors, manufacturers, and publishers may discontinue these products at any time.

The suggested activities section of the unit also includes supplements and transparency masters. Each of these components provides information in a special way. Supplements may consist of motivational materials, review or practice materials such as crossword puzzles and self-tests, or charts and reference materials. Supplements are designed to be copied and distributed to individual class members or to the class as a whole. Suggestions for their use are included in the instructor's guide. Transparencies direct the class' attention to the topic of discussion. Transparencies may present new information, or they may reinforce information presented in the information sheet. They are particularly effective when identification or analysis is necessary. Order transparencies from the Curriculum and Instructional Materials Center, or make transparencies and place them in the notebook where they will be immediately available for use.

Information Sheet (green pages)

The information sheet provides "must know" content essential for meeting the cognitive (knowledge level) objectives of the unit. The information is written in a topical-outline form and is keyed to the specific objectives.

Teachers will find that the information sheet serves as an excellent guide for presenting background knowledge necessary to develop the skills specified in the unit objective. The information sheet may also be used for coordination activities and advisory committees.

Students should read the information sheet before the information is discussed in class. Space is provided in margins for students and teachers to add notes that supplement, localize, personalize, or provide motivation for each unit.

Assignment Sheets (brown pages)

Assignment sheets give students a chance at problem solving, self-assessment, and/or practical experience. They assist students in the application of knowledges that are necessary prerequisites to skill development. Assignment sheets may be given to the student for completion in class or may be used for homework assignments. Answer sheets are provided when appropriate and can be used by the student and/or teacher for checking student progress. The scores of those assignment sheets listed in the specific objectives should be averaged with the unit test score, as the skills addressed in these assignment sheets are considered necessary in meeting the unit objective.

Job Sheets (blue pages)

Job sheets are another important segment of a unit of instruction. The job sheets provide a list of equipment, tools, and materials needed to complete a manipulative or psychomotor skill. They describe a step-by-step procedure needed to complete each task or job. Diagrams, photographs, and illustrations are provided to assist students in achieving the skill.

The teacher should demonstrate to students the procedures outlined in each job sheet. Furthermore, the teacher needs to localize the job sheet according to the equipment and supplies available in the local lab or shop situation. Job sheets also furnish potential employers with a picture of the skills being taught and the performances they might reasonably expect from a person who has had this vocational instruction.

Job sheet performance should be evaluated by the instructor and averaged with the unit test score, as the skills addressed in the job sheets are considered necessary in meeting the unit objective.

Tests (yellow pages)

The test provides criterion-referenced evaluation of every objective listed in the unit of instruction. It is crucial to note that both paper/pencil and performance objectives must be evaluated.

It is recommended that the tests be divided into shorter tests covering three or four objectives at a time and given soon after those objectives have been covered. A selection of questions from the units covered may be used for final tests at the end of each term if desired. If objectives have been added, deleted, or modified, be sure to make the changes on the test.

The acceptable response on a unit test, 85 percent in most units, may be raised or lowered to fit the topic or students' ability levels. The percentage applies to the overall score, not to each question. The final unit grade should be obtained by using the paper/pencil score and evaluations of student demonstrations of the desired skills.

Answers to Test and Assignment Sheets (pink pages)

Answers to test and assignment sheets are components designed to assist the teacher in evaluation of student performances.

Page Numbering

Each publication from the Curriculum and Instructional Materials Center (CIMC) is assigned a specific abbreviation. For example, *Fundamentals of Concrete and Cement Masonry* has been abbreviated FCCM. The units are then numbered consecutively within each section. An example of a page number is FCCM-1-A. Since CIMC publications are loose leaf, this system of page numbering was adopted so that pages from different manuals would not get mixed up.

Methods of Disseminating Material

Material may be given out a unit or page at a time to keep the material before the student always new. Some teachers ask students to furnish a three-ring binder for the units. This is convenient for taking the materials home to study. Upon completion, each unit is then placed in a larger binder. The large binders may be purchased at cost from the CIMC. Some teachers store the materials by units in filing cabinets or boxes until needed. All the units may be given out at once if desired.

For best results, provide student materials for each student. Student materials contain everything but the test answers, answers to assignment sheets, and suggested activities. All tests are collated at the back of student material and should be removed and stored until needed.

Teaching Methods

It is a challenge to keep students motivated. Supplement the objectives by providing the "why," personal experiences, and current information. Prepare for each unit by deciding how each objective can best be taught. Allow students to become involved in preparing and planning.

Competency Profiles

Competency profiles are folders used to document student performance. The profile contains a list of the specific job competencies that a student should achieve prior to leaving the training program. Competency profiles may be ordered from the State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, and from The Associated General Contractors of America, 1957 E. Street N.W., Washington, D.C. 20006.

CORRECTIONS AND SUGGESTIONS

The Curriculum and Instructional Materials Center (CIMC) wants to provide vocational instructors and students with materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications, or have suggestions for improving their usefulness in vocational programs, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and to indicate the correction on the copy. You can mail the information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, it is important that you notify the CIMC of necessary corrections as soon as possible after discovering the error. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

Assistant Coordinator for Development
Curriculum and Instructional Materials Center
Oklahoma State Department of Vocational and
Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074

FREE-ENTERPRISE SYSTEM
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to explain how the free-enterprise system works. The student will show this ability by completing the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with the free-enterprise system.
2. Match components of an economic system to their correct descriptions.
3. List the functions of an economic system.
4. Describe characteristics of a free-enterprise economy.
5. Select from a list facts about consumers in a free-enterprise economy.
6. List ways in which price is determined in a free-enterprise economy.
7. Select from a list ways in which price influences flows in a free-enterprise economy.
8. Match to their correct descriptions economic goals in a free-enterprise system.

FREE-ENTERPRISE SYSTEM
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

      1. Supplement #1 — Free-Enterprise System Crossword Puzzle

      2. Transparency Master #1 — Free-Enterprise Flow Chart

   C. Information sheet

   D. Assignment sheets

      1. Assignment Sheet #1 — Analyze Characteristics of a Free-Enterprise Economy

      2. Assignment Sheet #2 — Interpret a Free-Enterprise Flow Chart

      3. Assignment Sheet #3 — Interpret Price Influences in a Free-Enterprise Economy

      4. Assignment Sheet #4 — Collect Information on the Role of Government in a Free-Enterprise Economy

   E. Answers to assignment sheets

   F. Test

   G. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials necessary to supplement unit.

      1. Transparency and competency profiles

         (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006; phone [202] 393-2040.)

SUGGESTED ACTIVITIES

2. Copies of Supplement #1

3. Films

   a. *American Enterprise Series: Land.* Color, 29 minutes, Modern Talking Picture Service, 1976.

   b. *American Enterprise Series: Government.* Color, 29 minutes, Modern Talking Picture Service, 1976.

   c. *American Enterprise Series: Innovation.* Color, 29 minutes, Modern Talking Picture Service, 1976.

   (NOTE: This series is available on a free-loan basis to Oklahoma instructors. Oklahoma instructors may order from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074. Out-of-state instructors must order from Modern Talking Picture Service, 45 Rockefeller Plaza, New York, New York 10020.)

C. Introduce unit to students.

SUGGESTIONS:

- Discuss economics in general and relate the concept of supply and demand to real concerns of your students, such as buying a car, living on their own, and the costs of clothes or dating.
- Play Monopoly or a similar game that uses free-enterprise theories, or use such games to illustrate concepts of the free-enterprise economy.
- Make a bulletin-board display of magazine and newspaper reports on the economy and economic indicators.

(NOTE: The National Federation of Independent Business prints a poster entitled "What's the Difference?" that compares the standards of living in Washington, D.C.; London, England; and Moscow, U.S.S.R. Copies are available free of charge to teachers ordering on school stationery from the National Federation of Independent Business, 150 West 20th Avenue, San Mateo, California 94403.)

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, emphasizing that a number of the students may become independent contractors and that all of them will act as producers and consumers throughout their adult lives.

SUGGESTIONS:

- If possible, obtain concrete-mason-related statistics about job placement and the number of students who become independent contractors.
- Provide students with cost figures and other information regarding projects completed in your program in the past.
- Invite some independent contractors or construction company managers to discuss how their businesses are affected by free enterprise.

SUGGESTED ACTIVITIES

F. Provide students with information and assignment sheets.

G. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss terms associated with the free-enterprise system.

   SUGGESTIONS:

   - Use Supplement #1, "Free-Enterprise System Crossword Puzzle," to reinforce terms.
   - Have the students discuss the terms, using examples that they can relate to, such as their own personal property and competition on the football field or in completing a concrete project.

2. Use Information Sheet, Sections II and III, to discuss the essential components and the functions of the free-enterprise economy.

   SUGGESTION:

   - Relate the components and functions to games such as Monopoly.

3. Use Information Sheet, Section IV, to discuss the characteristics of a free-enterprise economy.

   SUGGESTIONS:

   - Have students complete Assignment Sheet #1, "Analyze Characteristics of a Free-Enterprise Economy," to reinforce your discussion.
   - Use Transparency #1, "Free-Enterprise Flow Chart," to illustrate the characteristics of a free-enterprise system.
   - Hand out a copy of Transparency #1 to each student, and have students complete Assignment Sheet #2, "Interpret a Free-Enterprise Flow Chart," to reinforce their understanding of the characteristics of a free-enterprise economy.
   - Show film *American Enterprise Series: Land* to illustrate the concept of private property and to introduce the idea of supply.
   - Lead a group discussion to explore the history of a product with which the students are familiar to see how competition lowers prices and introduces improvements.

     EXAMPLES: Personal computers, video recorders, telephone service

   - Assign individuals or groups reports on the economic opportunities (or lack of opportunities) under other government systems.

SUGGESTED ACTIVITIES

4. Use Information Sheet, Section V, to discuss the roles of the consumer within the free-enterprise functions of allocation, flow maintenance, and coordination.

   SUGGESTIONS:

   - Show the film *American Enterprise Series: Innovation.*
   - Provide the students with stories about successful entrepreneurs, especially those in real estate and construction.
   - Have the class discuss their own roles as consumers.
   - Invite a local contractor or business person, or a group of such persons, to discuss work ethics, absenteeism, and other labor characteristics that impact upon production.
   - When discussing how producers raise the standard of living for consumers and how this has greatly increased the amount of leisure time, have the students think of time-saving products that are on the market now that were not on the market during their parents' or grandparents' early years. List their suggestions on the chalkboard.

     EXAMPLES: *Paper products*: Plates, tissues, diapers, napkins, bibs, etc.

     Disposable products: Syringes, thermometers, razor blades, lighters, etc.

     Services: Baby-sitting, housecleaning, painting, child-care centers

5. Use Information Sheet, Sections VI and VII, to discuss how price is determined and how it influences flows in the free-enterprise system.

   SUGGESTIONS:

   - Have students complete Assignment Sheet #3, "Interpret Price Influences in a Free-Enterprise Economy," and #4, "Collect Information on the Role of Government in a Free-Enterprise Economy," to reinforce these concepts.
   - Have the students contact various speciality contractors such as electricians, plumbers, and materials suppliers to compare prices.
   - Lead the class in a discussion of how price enters into their own buying decisions.
   - Use trade magazines to determine concrete costs per square foot in various sections of the country and to explore factors that may influence those costs, such as wages for construction workers, the costs of materials, and the overall cost of living in each area.

SUGGESTED ACTIVITIES

6. Use Information Sheet, Section VIII, to discuss the economic goals of the American people.

   SUGGESTIONS:

   - Define the American enterprise system as a *modified free-enterprise system.* Explain how the various levels of government intervene in the economic process so that the system is not totally "free." Relate ways in which government regulations are often designed to promote the economic goals listed, such as ensuring efficiency, stability, and justice.
   - Have the class discuss the importance of these goals in their own lives.

H. Give test.

I. Critique test and discuss test in class.

J. Reteach if necessary.

K. Complete appropriate section of competency profiles.

III. Unit references

A. Amos, Joe. *Distributive Education I: Course of Study.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1973.

B. Hendrix, Laborn J. "Bud." *Heavy Equipment Operator Basic Core.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1981.

C. Nelson, Frank W. *Group Instruction for Cooperative Programs.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1978.

D. Nelson, Robert E., James A. Leach, and Thomas J. Scalan. *Owning and Operating a Small Business: Strategies for Teaching Small Business Ownership and Management.* State Board of Education, Illinois Office of Education, June, 1976.

E. Olsen, Arthur R., and John W. Kennedy. *Economics: Principles and Applications,* 9th ed. West Chicago, Illinois: South-Western Publishing Company, 1978.

F. *Small Marketers Aid No. 71.* "Checklist for Going into Business." Washington, D.C.: Small Business Administration, August, 1970.

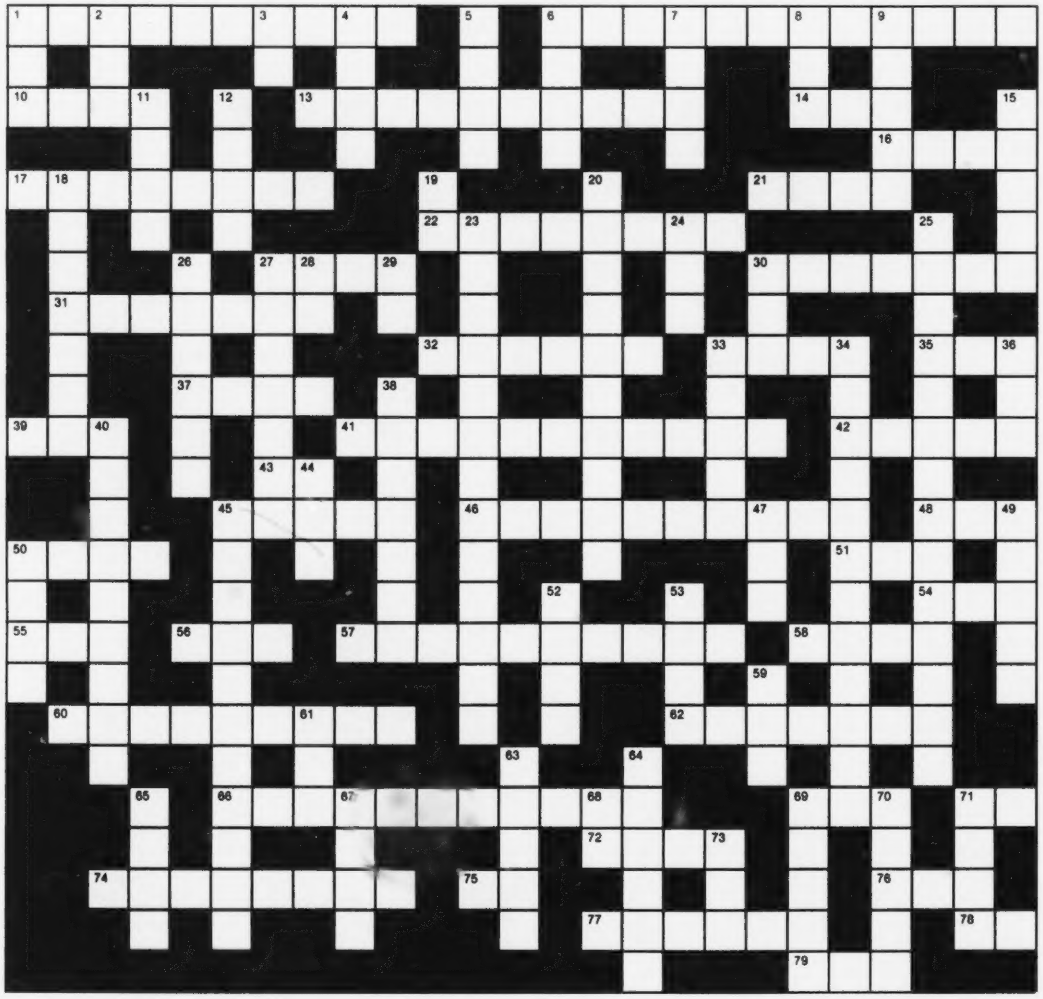
(NOTE: This booklet may be obtained free of charge by contacting the nearest office of the Small Business Administration.)

G. Wyllie, Eugene D., and Roman F. Warmke. *Free Enterprise in the United States.* Cincinnati, Ohio: South-Western Publishing Company, 1980.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — FREE-ENTERPRISE SYSTEM CROSSWORD PUZZLE

Review your understanding of terms and definitions associated with a free-enterprise system by completing the crossword puzzle below. Clues and solution are on the following pages.



SUPPLEMENT #1

ACROSS

1. Benefit
6. Influence of group and individual decisions on economic system
10. Special offering of goods at prices lower than usual
13. Person or persons tasked with coordinating resources toward making a profit
14. Salary after taxes and deductions
16. Length times width
17. Work done or duties performed for another
21. Opposite of stockmarket "bear"
22. Labor, land, water, or fuel
27. Piece of metal used as money
30. Unfavorable or harmful
31. Type of resource
32. Money that a producer has left after selling goods or services and paying all expenses required in the production process
33. Federal Deposit Insurance Corporation (abbr.)
35. Extrasensory perception (abbr.)
37. Opposite of 54 across (abbr.)
39. Big Apple (abbr.)
41. Efforts made to attract consumers by two or more producers offering similar goods or services
42. Medium of exchange in the U.S.
43. Preposition
45. Exchanges of goods and services for money
46. Undertaking or project; a business
48. Long, thin fish
50. Opposite of 32 across
51. Neither . . .
54. Property held by the government for use by all citizens (abbr.)
55. Numeral (abbr.)
56. Decision of a court or legislature; law, decree
57. Process of controlling, directing, or governing according to a rule, principle, or system
58. Two of a kind
60. Those who provide goods and services
62. Plural of 32 across
66. Type of economic system
69. Gross National Product (abbr.)
71. Gram (abbr.)
72. Periods
74. Distribute
75. Street (abbr.)
76. International Trade Association (abbr.)
77. Amount of a resource, good, or service that will be bought by consumers at a specific time for a given price
78. Pound (abbr.)
79. To bring legal suit

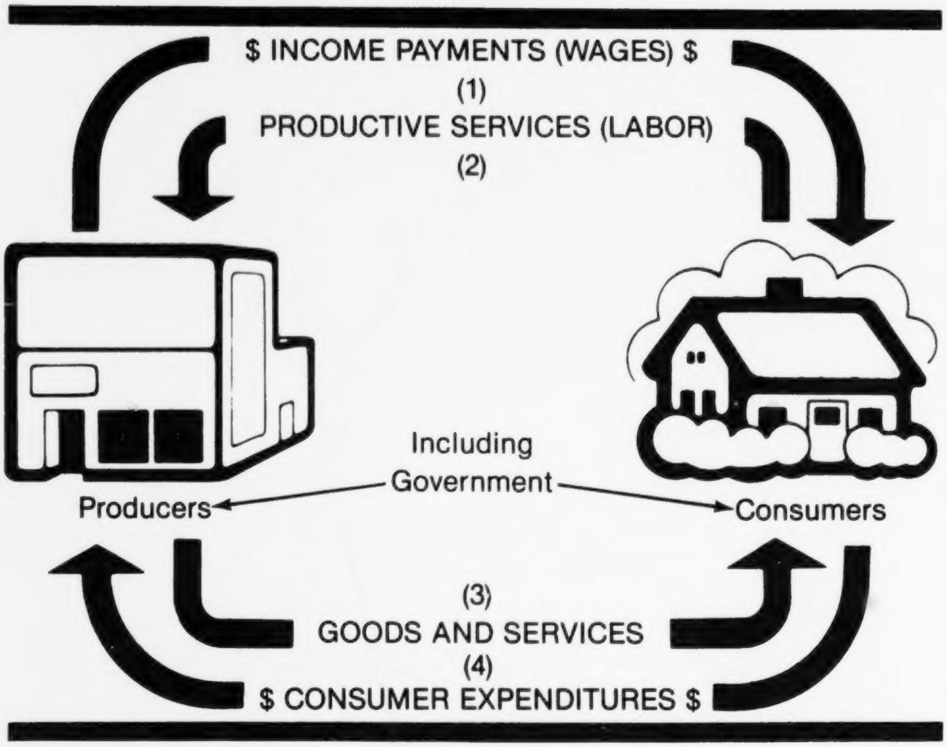
DOWN

1. Internal Revenue Service (abbr.)
2. Dollar (abbr.)
3. Money order (abbr.)
4. Tidy
5. Money received in exchange for a service performed
6. Past tense of *come*
7. Fixed ratio or proportion; the - - - - of exchange
8. Prefix meaning *not*
9. Sum
11. Jealousy
12. Federal Insurance Contributions Act (abbr.)
15. Worth of an item; price or cost
18. System of producing, distributing, and consuming wealth
19. Price (abbr.)
20. Supports with a grant of money
23. Persons who organize and manage a business, assuming the risk of the business for the purpose of making a profit
24. Decrease in salary
25. Type of economic system that allows individual economic decisions (2 wds.)
26. Amount of resources, goods, or service that is available for exchange at a specific time for a given price
27. Wealth (money or property) used or capable of being used in production
28. Old Latin (abbr.)
29. Negative answer
30. Addition (abbr.)
33. That part of stock exchange upon which members stand
34. Anything given as an equivalent; payment for services
36. Take-home - - -
38. Use up products or services
40. Those who pay to receive goods and services
44. Total (abbr.)
45. Continual and irregular change; up and down movement
47. Interest (abbr.)
49. Physical and mental effort required to design, produce, and deliver goods and services
50. One of our natural resources
52. Money-lending institution
53. Corporation (abbr.)
59. 2000 pounds
61. Equal Rights Amendment (abbr.)
63. Value or cost of items as determined by producers and consumers
64. Another name for directed economic system; also opposite of *open*
65. Opposite of *buy*
67. Month, day, year
68. Advertisement (abbr.)
69. Partner of 17 across
70. Value asked
71. Objective; aim
73. Small Business Administration (abbr.)

SOLUTION TO SUPPLEMENT #1

1 I	N	2 D	U	C	E	3 M	E	4 N	T		5 W		6 C	O	O	7 R	D	I	8 N	A	9 T	I	O	N
R		O				O		E			A		A			A			O		O			
10 S	A	L	11 E		12 F		13 M	A	N	A	G	E	M	E	N	T			14 N	E	T			15 V
			N		I			T			E		E			E					16 A	R	E	A
17 S	18 E	R	V	I	C	E	S			19 P				20 S				21 B	U	L	L			L
	C		Y		A					22 R	23 E	S	O	U	R	24 C	E					25 F		U
	O			26 S		27 C	28 O	I	29 N		N			B		U		30 A	D	V	E	R	S	E
	31 N	A	T	U	R	A	L		O		T			S		T		D				E		
	O			P		P				32 P	R	O	F	I	T		33 F	D	I	34 C		35 E	S	36 P
	M			37 P	R	I	V		38 C		E			D			L			O		E		A
39 N	Y	40 C		L		T		41 C	O	M	P	E	T	I	T	I	O	N		42 M	O	N	E	Y
		O		Y		43 A	44 T		N		R			Z			O			P		T		
		N			45 F	L	O	W	S		46 E	N	T	E	R	P	R	47 I	S	E		48 E	E	49 L
50 L	O	S	S		L		T		U		N			S				N		51 N	O	R		A
A		U			U				M		E		52 B			53 C		T		S		54 P	U	B
55 N	U	M		56 A	C	T		57 R	E	G	U	L	A	T	I	O	N		58 P	A	I	R		O
D		E			T						R		N			R		59 T		T		I		R
	60 P	R	O	D	U	C	61 E	R	S		S		K			62 P	R	O	F	I	T	S		
		S			A		R					63 W			64 C			N		O		E		
			65 S		66 T	R	A	67 D	I	T	I	O	N	68 A	L				69 G	N	70 P		71 G	M
			E		I			A				R		72 D	O	T	73 S		O		R		O	
		74 A	L	L	O	C	A	T	E		75 S	T			S		B		O		76 I	T	A	
			L		N			E				H		77 D	E	M	A	N	D		C		78 L	B
															D				79 S	U	E			

Free-Enterprise Flow Chart


$ INCOME PAYMENTS (WAGES) $
(1)
PRODUCTIVE SERVICES (LABOR)
(2)
Including
Government
Producers
Consumers
(3)
GOODS AND SERVICES
(4)
$ CONSUMER EXPENDITURES $

EXPLANATION

1. How production is shared — payment for resources (both labor and materials) according to how they satisfy consumer wants.

2. How to produce — the use of productive services (land, labor, capital, and management) in a production process to satisfy wants.

3. How much to produce — amount of goods and services produced as determined by consumer spending.

4. What to produce — the demand for goods and services as expressed by consumer spending.

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FREE-ENTERPRISE SYSTEM
UNIT I

INFORMATION SHEET

I. Terms and definitions associated with the free-enterprise system

A. Enterprise — Undertaking or project; a business

B. Economic system — Design, normally established by a government, to control the production, distribution, and consumption of goods and services

EXAMPLES: Free enterprise, closed, traditional

C. Free-enterprise system — Economic system in which decisions are made primarily by individuals who have the freedom to choose how they will spend their money, invest their time, and set their economic goals

D. Flow — Exchange of goods and services for money

E. Allocation — Distribution of goods and services

F. Compensation — Anything given as an equivalent; payment for services

G. Labor — Physical and mental effort required to design, produce, and deliver goods and services

H. Natural resources — Land, water, fuels, and raw materials required for production

I. Capital — Wealth (money or property) used or capable of being used in production

J. Management — Person or persons tasked with coordinating resources toward making a profit

K. Regulation — Process of controlling, directing, or governing according to a rule, principle, or system

L. Entrepreneur — Person who organizes and manages a business, assuming the risk of the business for the purpose of making a profit

M. Economic value — Worth of an item in satisfying the wants and needs of producers and consumers; price or cost

N. Medium of exchange — Anything used as a measure of value in exchange for goods and services

EXAMPLES: Currency, checks, services

O. Supply — Amount of resources, goods, or service that is available for exchange at a specific time for a given price

INFORMATION SHEET

P. Demand — Amount of resources, goods, or service that will be bought by consumers at a specific time for a given price

Q. Profit — Money that a producer has left after selling goods or services and paying all expenses required in the production process

R. Goods — Something that has economic value

II. Components of an economic system

A. Goods and services — Material objects and assistances provided to satisfy the wants or needs of individuals who are willing to pay to obtain them

EXAMPLES: *Goods:* Food, clothing, housing, books, tools, lumber

Services: Cooking, tailoring, construction, printing, tool repair, equipment rental

B. Resources — Materials, facilities, planning, and organization required to produce and distribute goods and services

(NOTE: Resources are sometimes referred to as *factors of production.* Economists break resources into four categories: labor, land or natural resources, capital, and management.)

C. Producers — Those who provide goods and services

D. Consumers — Those who pay to receive goods and services

E. Regulating factors — Aspects of the economic system that determine allocation, flows, and coordination

(NOTE: A regulating factor may be part of the economic philosophy of the system, such as religious beliefs in a traditional system or freedom of choice in a free-enterprise system, or the regulation may be imposed by an individual or agency, such as a government in a closed system.)

F. Medium of exchange — Means used to provide compensation for resources or goods and services

(NOTE: The medium of exchange in an economic system is the basis for placing values on all that is bought and sold. Generally, a monetary system is established and used as the basis of relative values. This allows comparisons to be made, for example, between the value of a skilled concrete mason's time and the value of a trowel machine. However, exchanges may be made without a monetary system, either by comparing the value of two things directly or by using another standard such as gold.)

INFORMATION SHEET

III. Functions of an economic system

A. Resource allocation

B. Maintenance of flows

C. Coordination

(NOTE: Coordination is the influence on the economic system of group and individual decisions.)

IV. Characteristics of a free-enterprise economy

A. Private property — That portion of personal income kept by the individual in the form of money, owned material goods, and investments such as stocks and bonds

(NOTE: In a free-enterprise system, the majority of property is privately owned, being held either by individuals or by individuals through private businesses. Some property, such as public schools, highways, and national and state parks, is referred to as *public property* because it is held by the government for the use of all citizens. Under some economic systems there is little or no ownership on the part of private citizens.)

B. Freedom of choice — Right of consumers to spend their money as they desire and of producers to become involved in any legal business

(NOTE: Freedom of choice is essential in a free-enterprise economy. The choices made by consumers help to determine what producers will provide, how much of it will be provided, and the price at which it will be sold.)

C. Profit motivation — Desire of producers to increase their private-property holdings

(NOTE: The desire to make a profit leads entrepreneurs to establish businesses, which in turn creates jobs and provides additional or better goods and services.)

D. Competition — Efforts made to attract consumers by two or more producers offering similar goods or services

(NOTE: Competition between producers in a free-enterprise economy is a chief factor in the production of quality products at low prices. Competitors attempt to attract consumers by offering lower prices, added services or features, new or improved products, or by other means attractive to consumers.)

INFORMATION SHEET

V. Facts about consumers in a free-enterprise economy

   A. Allocation

      1. Consumers determine where natural resources and labor may be used

      2. Consumers make buying decisions that determine what is produced and how much is needed, thus influencing the use of resources

   B. Flows

      1. Consumers make buying decisions that determine how much will be paid for goods and services

      2. Consumers make buying decisions that influence how much of a product is required and where it will be distributed

   C. Coordination

      1. Consumers make buying decisions that help to set standards for industry

         EXAMPLE: Buyers expect a certain level of performance and dependability and certain standard features in the cars they purchase.

      2. Consumers affect the rate of growth in the economy through spending decisions and desires for goods and services

VI. Ways in which price is determined in a free-enterprise economy

   A. Availability of resources

   B. Collective buying decisions of consumers (demand)

      EXAMPLE: Several years ago large American automobiles were selling better than small foreign automobiles. Today, consumers are purchasing more foreign automobiles. This demand has caused the price and supply of foreign automobiles to rise rapidly; the price of American automobiles has increased, but at a much slower rate.

   C. Marketing surveys and reviews of past sales to determine what goods and services consumers will buy and at what price

INFORMATION SHEET

VII. Ways in which price influences flows in a free-enterprise economy

A. Determines what will be produced by showing what goods and services are profitable

EXAMPLE: The selling price of sand is $3.75 per ton, and it costs the contractor $4.25 per ton to excavate; sand is not a profitable product for the contractor to sell.

B. Determines allocation of scarce resources

EXAMPLE: If diesel fuel is selling for $1.15 per gallon and kerosene is selling for $.90 per gallon, oil available to produce kerosene or diesel fuel will be used primarily to produce diesel fuel.

(NOTE: The producer will offer the product that will show the most profit.)

C. Determines methods of production for a good or service

EXAMPLE: If a home contractor can use a cheaper grade lumber to build a home and the consumer does not care, the contractor can reduce the cost of the product.

D. Determines what consumers are able to buy

EXAMPLE: If your income is $20,000 per year and you have no savings, you will not be able to buy a $250,000 home.

VIII. Economic goals in a free-enterprise economy

(NOTE: One of the factors in any economic system is the influence of traditions and social beliefs. In fact, these traditions and beliefs are largely responsible for determining what kind of economic system is in effect. The following is a list of the more important goals that influence allocation, flows, and coordination in a free-enterprise economy.)

A. Economic freedom — Right of producers and consumers to make economic decisions

B. Economic efficiency — Desire to use limited resources in the most productive and beneficial way

C. Economic growth — Desire for an ever-increasing standard of living

D. Economic stability — Freedom from major fluctuations in a nation's economy

EXAMPLES: Fluctuations include depressions and recessions; and great changes in interest rates, value of the monetary system, and employment rate.

INFORMATION SHEET

E. Economic justice — Fair distribution of society's resources and economic advantages

(NOTE: *Fair distribution* does not necessarily mean *equal* distribution. In a free-enterprise system, rewards go to those who have special skills, special knowledge, and greater abilities to contribute to the good of society. Thus, the more one produces for the good of society—as viewed by the society—the more one will obtain from the society.)

F. Economic security — Desire for a certain minimum standard of living for all members of the society

(NOTE: Social programs such as Medicare and urban renewal are attempts by the society to see that citizens who suffer hardship due to age, illness, unavoidable unemployment, economic fluctuations, and other adverse situations are not abandoned. Such efforts try to provide the disadvantaged with a share of the society's economic wealth.)

FREE-ENTERPRISE SYSTEM
UNIT I

ASSIGNMENT SHEET #1 — ANALYZE CHARACTERISTICS OF A FREE-ENTERPRISE ECONOMY

NAME ________________________________ SCORE ______________

The characteristics of a free-enterprise economy—private property, freedom of choice, profit motivation, and competition—are all interrelated. For example, a town may have only one roofing company that is able to handle the normal roofing needs. This company sets its prices high because of a lack of competition. Yet, after a hailstorm, the consumers' need for roofing increases, creating a larger market. As a result, roofing contractors from outside the town may send crews to the town to share in the potential profit caused by the expanded market. The original company will probably have to lower prices in order to compete.

Use your local telephone book to analyze the characteristics of a free-enterprise economy. This exercise will give you a good idea of how many businesses in your area are competing with each other for the consumers' dollars.

PART I

Use the Yellow Pages of your telephone book to determine the number of business firms competing for consumers' dollars for the following goods and services. Write the names of the companies or businesses in the blanks provided.

A. Equipment rentals

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________

B. Excavating companies

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________

ASSIGNMENT SHEET #1

C. Income-tax services

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________

D. Lumberyards

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________

E. Concrete plants

1. ____________________
2. ____________________
3. ____________________
4. ____________________

F. Hospitals (general medical and services)

1. ____________________
2. ____________________
3. ____________________
4. ____________________

PART II

Analyze the information collected in the survey to answer the following questions.

A. Which business appears to have the most competition for consumers' dollars? Explain your answer.

____

____

____

B. How do most firms demonstrate the free-market system?

____

____

____

ASSIGNMENT SHEET #1

C. What did the survey show you about profit motivation and business firms in your area?

____

____

____

D. What did the survey show about the use of private property by business?

____

____

____

PART III

Read the following case studies that demonstrate characteristics of the free-enterprise system at work. Write an "X" in the blanks before the characteristics you believe are at work, and explain your answers. More than one answer may be correct.

A. Jane Smith has $35,000 in savings and plans to use the money to start a concrete contracting company. Jane conducted a survey of the people in the city in which she wants to locate the business. The survey shows a need for a concrete contracting company, so Jane decides to open the business.

______ 1. Private property

Why?______________________________

____

____

______ 2. Freedom of choice

Why?______________________________

____

____

______ 3. Profit motivation

Why?______________________________

____

____

ASSIGNMENT SHEET #1

_____ 4. Competition

Why?____

____

____

B. John Jones owns and operates a power-tool store. John employs four salespeople and a stock clerk. He has decided to change his business from a full-service to a self-service store in an effort to lower expenses and increase profits. The number of employees will be reduced to two, a cashier and a stock person.

_____ 1. Private property

Why?____

____

____

_____ 2. Freedom of choice

Why?____

____

____

_____ 3. Profit motivation

Why?____

____

____

_____ 4. Competition

Why?____

____

____

ASSIGNMENT SHEET #1

C. Pat James owns and operates a small lumberyard. Pat has decided to increase the goods provided by the shop in an effort to offer items that the other lumberyard in town does not carry. The goods that will be added are hand tools and equipment. Pat will have to borrow $10,000 from a relative to add these goods.

_____ 1. Private property

Why?____________________

_____ 2. Freedom of choice

Why?____________________

_____ 3. Profit motivation

Why?____________________

_____ 4. Competition

Why?____________________

FREE-ENTERPRISE SYSTEM
UNIT I

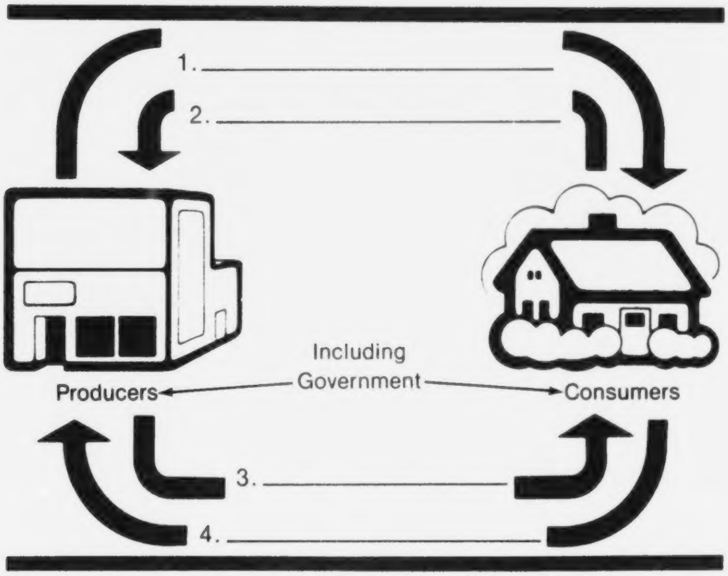
ASSIGNMENT SHEET #2 — INTERPRET A FREE-ENTERPRISE FLOW CHART

NAME ________________________________ SCORE ______________

One of the most important concepts to understand about the free-enterprise system is the constant exchange that goes on between producers and consumers, and how such flows affect supply and demand. Even if you never own your own business, you will be offering your skills and time as products for sale, with your wages being the payment for your product. Additionally, you will act as a consumer of goods and services provided by others.

Your instructor will hand you a copy of a free-enterprise flow chart. Interpreting the flow chart will help you understand how basic economic questions are determined in a free-enterprise economy.

A. Label the flow chart below.



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B. How would the following changes within the free-enterprise economy normally affect flows in the system? Write an "X" in the blank before each correct answer.

1. If consumers' demand for goods and services increases, and the producer provides more goods and services, the producer's demand for productive services (land, labor, capital, and management) will

______a. Increase ______b. Decrease ______c. Not change

ASSIGNMENT SHEET #2

2. If the producer demands more productive services and the consumers supply more, payment to consumers for productive services will

   ______a. Increase ______b. Decrease ______c. Not change

3. If consumer expenditures for goods and services increase, the amount of goods and services produced will

   ______a. Increase ______b. Decrease ______c. Not change

4. If the producer pays less for productive services, the amount paid by consumers for goods and services should

   ______a. Increase ______b. Decrease ______c. Not change

5. If the producer produces fewer goods and services and consumer expenditures indicate a demand for equally fewer goods and services, the cost paid by consumers for goods and services should

   ______a. Increase ______b. Decrease ______c. Not change

6. If consumers provide more productive services while the producer's demands for productive services remain the same, the amount the producer pays for productive services should

   ______a. Increase ______b. Decrease ______c. Not change

FREE-ENTERPRISE SYSTEM
UNIT I

ASSIGNMENT SHEET #3 — INTERPRET PRICE INFLUENCES IN A FREE-ENTERPRISE ECONOMY

NAME ______________________ SCORE __________

One of the major considerations experts use to analyze the economy is the number of new home starts and building permits issued. Our country's economy is closely tied to the state of the construction trades. As you become involved in this field, you will grow more aware of your role in influencing the economy and, in turn, more aware of how your business and standard of living are influenced by the economy.

Interpreting the following case studies will help you examine some of the relationships in a free-enterprise economy. Refer to Information Sheet, Sections VI and VII, as needed.

A. The Bryan Construction Company is planning to add one more floor plan to its housing development series. The company is considering two floor plans. The company estimates that they can sell ten houses of floor plan A at a profit of $14,000 each; or they can sell twelve houses using floor plan B, at a profit of $11,500 each.

Which floor plan should the company select to sell? Explain.

B. John and Susan Johnson are planning to buy a new location for their tool business. They have looked at two locations that they like. The locations are basically the same, except that location A includes 5 acres of land, and location B is a 100-foot lot. The monthly payments on location A are $1500, and the payments on location B are $1300. Based on their monthly income and their other financial obligations, the Johnsons decided that they could not afford location A.

What economic factor lead to the Johnson's decision? Explain.

ASSIGNMENT SHEET #3

C. A few years ago, there was a shortage of coffee in America. Because of this shortage, the coffee companies raised prices. Consumers objected to the price increase and began using less coffee. The decrease in the use of coffee affected the coffee companies' profits to the point that they decided to lower prices to a more reasonable level.

Discuss this supply and demand cycle in terms of consumer/producer relationships.

D. The Miller Precast Concrete Plant has decided to conduct a marketing survey and to review the previous year's sales records for precast slabs. The purpose of the survey and review is to determine the size of slabs the consumers will buy and the price that the consumer will pay.

What consumer/producer relationships may have influenced Miller's decision to conduct a survey and review sales records? Explain.

FREE-ENTERPRISE SYSTEM
UNIT I

ASSIGNMENT SHEET #4 — COLLECT INFORMATION ON THE ROLE OF GOVERNMENT IN A FREE-ENTERPRISE ECONOMY

NAME ________________________ SCORE ____________

One of the largest influences on the free-enterprise system is the role of the various levels of government as consumer, producer, and regulator. You will find that every phase of construction is used to meet the consumer needs of government, and that numerous government agencies and regulations apply specifically to the concrete trade. This assignment sheet will help you become familiar with some of the roles played by government in your trade.

PART I

Interview or contact by letter at least one agency from each of the following levels of government to determine the functions the agency performs and to see how government acts as a producer and regulator. Use the questions included in this assignment sheet to complete the interviews.

A. Federal

EXAMPLES: Federal Trade Commission
Food and Drug Administration
U.S. Postal Service
OSHA (Occupational Safety and Health Administration)
Department of Labor-Wage and Hour Administration
Social Security Administration

1. Name of agency ________________________

2. With what type of business does the agency work? ________________________

____

____

____

____

3. What goods or services does the agency provide to these businesses?

____

____

____

ASSIGNMENT SHEET #4

4. What regulatory or protective functions are performed for these businesses?

B. State

EXAMPLES: Department of Human Services (welfare office)
State Employment Office
State Highway Department
State Department of Health
Department of Consumer Affairs
Corporation Commission

1. Name of agency ____________________

2. With what type of business does the agency work? ____________________

3. What goods or services does the agency provide to these businesses?

4. What regulatory or protective functions are performed for these businesses?

ASSIGNMENT SHEET #4

C. County or city

EXAMPLES: Board of County Commissioners
County Clerk
County Tax Assessor
County Surveyor
Highway Inspector
Buildings and Codes Department
City Engineer

1. Name of agency ______________________________

2. With what type of business does the agency work? ______________________________

3. What goods or services does the agency provide to these businesses?

4. What regulatory or protective functions are performed for these businesses?

ASSIGNMENT SHEET #4

PART II

Government agencies also serve as consumers. Contact one of the companies listed below to determine how government relates to that business as a producer, regulator, and consumer.

EXAMPLES:
- Bank or savings and loan company
- Excavating contractor
- Concrete contractor
- Day-care center
- Telephone company
- Gas company or electric company
- Hospital or nursing home
- Demolition contractor
- Manufacturing business

Type of business ____

Name of business ____

A. What goods or services are provided for the business by the following levels of government?

1. Federal — ____

2. State — ____

3. County or city — ____

ASSIGNMENT SHEET #4

B. How is this business affected by the regulatory functions performed by the following levels of government?

1. Federal — ________________________________

2. State — ________________________________

3. County or city — ________________________________

C. What services or products does the company provide to each level of government?

1. Federal — ________________________________

2. State — ________________________________

3. County or city — ________________________________

FREE-ENTERPRISE SYSTEM
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

PARTS I and II evaluated to the satisfaction of the instructor

PART III

A. (2) Freedom of choice — As a producer, Jane is free to choose a business to operate

(3) Profit motivation — Jane's survey determined the need for a concrete contracting company in that city; Jane's decision to start the company is based on her desire to make money and the fact that the survey indicates that she should be able to.

(NOTE: Students may list private property as another characteristic at work. There is some basis for this conclusion, but the instructor should use such a situation as an opportunity to explain how Jane's investment of private property also functions as the use of resources by her company.)

B. (3) Profit motivation — John has taken steps to reduce his expenses in order to increase profits

(NOTE: Profit motivation is the primary characteristic at work here. A student may justify to some extent that John has exercised freedom of choice in changing the business. Although competition may make it necessary for John to take this action, that cannot be determined from the information given.)

C. (1) Private property — The investment of $10,000 by Pat's relative represents the use of private property in the free-enterprise system

(4) Competition — Pat's decision to offer the additional goods is an attempt to make the lumberyard more attractive to consumers by providing goods not offered by Pat's competitor

(NOTE: Again, freedom of choice and profit motivation are also at work, but the primary principles illustrated in this case are private property and competition.)

Assignment Sheet #2

A. 1. Income payments
2. Productive services (labor)
3. Goods and services
4. Consumer expenditures

B. 1. a
2. a
3. a
4. b
5. c
6. b

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #3

A. Plan A; the profit from the sale of Plan A equals $140,000, and the profit from the sale of Plan B equals $138,000. The sale of Plan A would result in an additional $2000 profit; the price of goods and services determines what will be produced by showing what goods and services are profitable

B. The price of goods and services determines what consumers are able to buy

C. The collective buying decisions of consumers determines the price for goods and services

D. Business and industry conduct marketing surveys and review past sales records in an effort to determine what goods and services consumers will buy and what price consumers will pay

Assignment Sheet #4 — Evaluated to the satisfaction of the instructor

FREE-ENTERPRISE SYSTEM
UNIT I

TEST

NAME ________________________________ SCORE ______________

1. Match to their correct definitions terms associated with the free-enterprise system. Write the correct numbers in the blanks. Definitions continue on the next page.

______a. Exchange of goods and services for money

______b. Distribution of goods and services

______c. Amount of resources, goods, or service that will be bought by consumers at a specific time for a given price

______d. Anything used as a measure of value in exchange for goods and services

______e. Worth of an item in supplying the wants and needs of producers and consumers; price or cost

______f. Process of controlling, directing, or governing according to a rule, principle, or system

______g. Wealth (money or property) used or capable of being used in production

______h. Physical and mental effort required to design, produce, and deliver goods and services

______i. Design, normally established by a government, to control the production, distribution, and consumption of goods and services

______j. Undertaking or project; a business

______k. Anything given as an equivalent; payment for services

______l. Land, water, fuels, and raw materials required for production

______m. Person or persons tasked with coordinating resources toward making a profit

______n. Person who organizes and manages a business, assuming the risk of the business for the purpose of making a profit

1. Enterprise
2. Economic system
3. Compensation
4. Labor
5. Natural resources
6. Flow
7. Goods
8. Medium of exchange
9. Demand
10. Economic value
11. Regulation
12. Free-enterprise system
13. Management
14. Entrepreneur
15. Allocation
16. Supply
17. Profit
18. Capital

TEST

______o. Amount of resources, goods, or service that is available for exchange at a specific time for a given price

______p. Money that a producer has left after selling goods or services and paying all expenses required in the production process

______q. Something that has economic value

______r. Economic system in which decisions are made primarily by individuals who have the freedom to choose how they will spend their money, invest their time, and set their economic goals

2. Match components of an economic system to their correct descriptions. Write the correct numbers in the blanks.

______a. Those who provide goods and services

______b. Materials, facilities, planning, and organization required to produce and distribute goods and services

______c. Aspects of the economic system that determine allocation, flows, and coordination

______d. Those who pay to receive goods and services

______e. Means used to provide compensation for resources or goods and services

______f. Material objects and assistances provided to satisfy the wants or needs of individuals who are willing to pay to obtain them

1. Goods and services
2. Consumers
3. Producers
4. Resources
5. Medium of exchange
6. Regulating factors

3. List the functions of an economic system.

a. ____

b. ____

c. ____

4. Describe characteristics of a free-enterprise economy.

a. Private property — ____________________________________

____

____

TEST

b. Freedom of choice — ______________________________

____

____

c. Profit motivation — ______________________________

____

____

d. Competition — ______________________________

____

____

5. Select from the following list facts about consumers in a free-enterprise economy. Write an "X" in the blank before each correct answer.

______a. Consumers determine where natural resources and labor may be used

______b. Consumers make buying decisions that determine what is produced and how much is needed, thus influencing the use of resources

______c. Consumers make buying decisions that determine how much will be paid for goods and services

______d. Consumers make buying decisions that influence how much of a product is required and where it will be distributed

______e. Consumers provide jobs

______f. Consumers provide the management necessary to supply goods and services

______g. Consumers make buying decisions that help to set standards for industry

______h. Consumers affect the rate of growth in the economy through spending decisions and desires for goods and services

6. List ways in which price is determined in a free-enterprise economy.

a. ______________________________

b. ______________________________

c. ______________________________

TEST

7. Select from the following list ways in which price influences flows in a free-enterprise economy. Write an "X" in the blank before each correct answer.

_____a. Determines what will be produced by showing what goods and services are profitable

_____b. Determines quality of goods and services

_____c. Determines methods of production for a good or service

_____d. Determines allocation of scarce resources

_____e. Determines what consumers are able to buy

8. Match to their correct descriptions economic goals in a free-enterprise system. Write the correct numbers in the blanks.

_____a. Desire for an ever-increasing standard of living

_____b. Desire for a certain minimum standard of living for all members of the society

_____c. Right of producers and consumers to make economic decisions

_____d. Desire to use limited resources in the most productive and beneficial way

_____e. Fair distribution of society's resources and economic advantages

_____f. Freedom from major fluctuations in a nation's economy

1. Economic freedom
2. Economic efficiency
3. Economic growth
4. Economic stability
5. Economic justice
6. Economic security

FREE-ENTERPRISE SYSTEM
UNIT I

ANSWERS TO TEST

1. a. 6
   b. 15
   c. 9
   d. 8
   e. 10
   f. 11
   g. 18
   h. 4
   i. 2
   j. 1
   k. 3
   l. 5
   m. 13
   n. 14
   o. 16
   p. 17
   q. 7
   r. 12

2. a. 3
   b. 4
   c. 6
   d. 2
   e. 5
   f. 1

3. a. Resource allocation
   b. Maintenance of flows
   c. Coordination

4. Description should include the following

   a. Private property — That portion of personal income kept by the individual in the form of money, owned material goods, and investments such as stocks and bonds
   b. Freedom of choice — Right of consumers to spend their money as they desire and of producers to become involved in any legal business
   c. Profit motivation — Desire of producers to increase their private-property holdings
   d. Competition — Efforts made to attract consumers by two or more producers offering similar goods and services

5. a, b, c, d, g, h

6. a. Availability of resources
   b. Collective buying decisions of consumers (demand)
   c. Marketing surveys and reviews of past sales to determine what goods and services consumers will buy and at what price

7. a, c, d, e

8. a. 3
   b. 6
   c. 1
   d. 2
   e. 5
   f. 4

AMERICA'S INFRASTRUCTURE
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss the nation's infrastructure system and interpret how this infrastructure will affect the nation's construction industry in the future. The student will show this ability by completing the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Define *infrastructure.*
2. Name general classes of infrastructures.
3. Select from a list the purposes of the infrastructure.
4. Discuss the present condition of the nation's infrastructure.

AMERICA'S INFRASTRUCTURE
UNIT II

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

    1. Supplement #1 — Executive Preview of America's Infrastructure

    2. Transparency masters

      a. TM #1 — Projected Labor Need

      b. TM #2 — Major Labor Shortfall

  C. Information sheet

  D. Assignment Sheet #1 — Conduct a Survey of Specific Infrastructure Repair Needs in Your Community

  E. Answers to assignment sheet

  F. Test

  G. Answers to test

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Obtain videotapes to supplement unit.

  (NOTE: The following videotapes are available to Oklahoma teachers on a free-loan basis from the Oklahoma State Department of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074-4364. Out-of-state teachers should contact the nearest AGC office.)

    1. *Building — Our Vertical Infrastructure.* Color, videotape on 1/2- or 3/4-inch VHS cassette.

    2. *AGC Infrastructure Medley 2.* Color, videotape on 1/2- or 3/4-inch VHS cassette.

  C. Order transparencies and competency profiles.

  (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

SUGGESTED ACTIVITIES

D. Introduce unit to students.

SUGGESTIONS:

- Use information from Supplement #1, "Executive Preview of America's Infrastructure," or provide the supplement to the students as a handout for discussion.
- Introduce the students to The Associated General Contractors of America (AGC) and other such groups.
- Invite an AGC representative or other person familiar with the infrastructure concept to talk to the class, emphasizing aspects of the infrastructure in your area.

E. Provide students with objective sheet.

F. Discuss unit and specific objectives, emphasizing how the infrastructure impacts on the construction industry.

G. Provide students with information and assignment sheets.

H. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to broaden your explanation of infrastructure.

   SUGGESTIONS:

   - Show the videotapes to illustrate the concept of infrastructure and to introduce the next section of the information sheet.
   - Relate the idea of the infrastructure to production and consumerism as discussed in Unit I, "The Free-Enterprise System," emphasizing the role of government and the nation's economic goals.

2. Use Information Sheet, Section II, to discuss general classes of infrastructures.

   SUGGESTIONS:

   - Relate the examples in this section and your own examples to the ideas of essential services and sustaining the standard of living.
   - Have the class identify and list specific buildings and structures in the community to illustrate the examples.

     (NOTE: You may want to save the list for use with Assignment Sheet #1, "Conduct a Survey of Specific Infrastructure Repair Needs in Your Community."

SUGGESTED ACTIVITIES

3. Use Information Sheet, Section III, to discuss the purposes of an infrastructure.

   SUGGESTIONS:

   - Relate the various infrastructures to their purposes.
   - Have the students list specific ways in which the purposes outlined in Section III are met.

4. Introduce Information Sheet, Section IV, by discussing the consequences of having an infrastructure that is unable to fulfill the stated purposes. Discuss the condition of the nation's infrastructure.

   SUGGESTIONS:

   - Use Table 1 to discuss needed infrastructure repairs, updating the information if possible.
   - Acquaint students with specific repair needs in your area by having them complete Assignment Sheet #1.
   - Have the students find and bring to class local newspaper articles dealing with infrastructure repair needs. Make a bulletin board display.
   - Use Transparency #1, "Projected Labor Need," and #2, "Major Labor Shortfall," to supplement a discussion of job needs. Update the information if possible.
   - Discuss what the condition of the infrastructure means in terms of jobs and job opportunities in the carpentry profession.

I. Collect photographs of infrastructure repair needs in your area. Encourage the class to undertake a project to do something about these needs, such as making the public aware of the conditions, or offering their services to local agencies to assist in repairing the infrastructure.

J. Give test.

K. Reteach and retest as necessary.

L. Complete appropriate section of competency profiles.

III. Unit reference — "Infra-Structure." *Constructor,* Vol. LXV, No. 5 (May 1983).

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — EXECUTIVE PREVIEW OF AMERICA'S INFRASTRUCTURE

The nation's infrastructure is its system of public facilities, both publicly and privately funded, which provides for the delivery of essential services and a sustained standard of living. This self-contained set of structures provides for our mobility, shelter, services, and utilities. It is the nation's highways, bridges, railroads, and mass transit systems. It is our sewers, sewage treatment plants, water supply systems, and reservoirs. It is our dams, locks, waterways, and ports. It is our electric, gas, and power-producing plants. It is our courthouses, jails, firehouses, police stations, schools, post offices, and government buildings.

America's infrastructure is the base upon which society rests. Its condition affects our lifestyles and security, and each is threatened by its unanswered decay.

America has no acceptable alternative to urgently developing a program to rebuild the nation's public facilities, the skeleton of public works that provides society's basic and supporting services.

The almost daily casualty list of failing public facilities includes highways, bridges, water supply systems, sewage treatment plants, pipelines, and dams. But beyond that, the victims of neglect include schools, utilities, parks, hospitals, libraries, firehouses, and jails. These facilities and services touch every aspect of everyone's life.

The presently identifiable program cost to meet presently identified needs is approximately $3 trillion, according to estimates compiled by The Associated General Contractors of America (AGC).

There can be no question about the national urgency. The problems are not merely serious. Many are beyond the point where deterioration begins to accelerate at alarming rates and the hazards begin to compound themselves. The percentages of facilities in serious decay suggest the brutal reality:

- Nearly half of the nation's bridges are too weak to adequately handle the traffic loads.
- Almost one of every two paved miles of roads needs to be resurfaced or completely rebuilt.
- About 13 percent of the country's aging dams are classified as "high hazard."
- America's railroads must replace half of their ties over the next five years.
- Nearly half of the nation's sewage treatment plants are preventing economic growth because of inadequate capacity.
- Municipal water systems throughout the country are collapsing, threatening the quality of the water people consume, or failing to keep up with the demand.

While the cost of repairs is great, there is no alternative, and the cost of delay is too high. The alternative to meeting the challenge is a continued and rapidly increasing deterioration in the nation's economic base, in the quality of life, and in the public's health. The General Accounting Office, for example, sees drinking water contamination "emerging as one of the most serious health and environmental problems facing our nation during the '80s."

SUPPLEMENT #1

A public facilities renewal program will also provide immense benefit to the economy and increased employment. Unemployment, which has weakened the nation's workforce, has hit nearly one million persons in the construction industry, about one out of every five. Each $1 billion spent on construction creates tens of thousands of on-site jobs and has a multiplier effect in related industries and fields that benefit from construction spending. For example, $1 billion spent on rebuilding our nation's highways would generate 13,100 on-site jobs and 63,000 jobs overall.

The complexity and scope of the nation's crumbling public facilities are a crisis and an opportunity. The crisis, as it becomes increasingly clear, threatens in very direct ways the nation's health, its safety, its economy, its workers, and its ability to meet the needs of today and tomorrow.

The opportunity is equally clear. It is to revitalize the national delivery of the vital services its citizens demand and to put them on a sounder financial base.

The needs could not be clearer, or more immediate. The price of delaying the task increases the ultimate cost to everyone.

Source: "AGC/CIMC Instructional Systems and Executive Preview" by John Friedemann, p. 3.

Projected Labor Need:

2.4 million workers by the 1990s

Retirements/job transfers	1,500,000
New jobs	+ 900,000
Total	2,400,000

Major Labor Shortfall:

1.8 million workers by the 1990s

Projected labor need	2,400,000
Labor produced in existing programs	– 600,000
	1,800,000

Who will build America?

AMERICA'S INFRASTRUCTURE
UNIT II

INFORMATION SHEET

I. Definition of *infrastructure*

Infrastructure — System of public and private facilities that provides for delivery of essential services to sustain a minimum standard of living

II. General classes of infrastructures

A. Building infrastructures

EXAMPLES: Housing; hospitals; schools; prisons; police and fire stations; libraries; museums; storage buildings; stadiums; courthouses; federal, state, and local offices

B. Municipal utilities infrastructures

EXAMPLES: Potable water systems, wastewater treatment plants, drainage systems, flood-control systems, curbs, gutters, sidewalks

C. Heavy industrial infrastructures

EXAMPLES: Locks, ports, waterways, dams, reservoirs, railroads, mass transit systems

D. Highway infrastructures

EXAMPLES: Highways, bridges, airports

III. Purposes of the infrastructure

A. To promote public health and safety

B. To provide transportation of goods and services

C. To aid in national defense

D. To improve quality of life and standard of living

E. To strengthen national economy

F. To produce energy

INFORMATION SHEET

IV. Present condition of the nation's infrastructure

A. The nation's infrastructure is greatly deteriorated and in need of immediate costly repairs (Table 1)

EXAMPLE:

TABLE 1: National infrastructure needs (in billions)

Identified need	Cost
Highways	$1570.3
Wastewater treatment	507.8
Drainage, minor flood control	169.4
Potable water (urban)	138.6
Hospitals	130.0
Housing (multifamily and low-income)	112.0
Dams/reservoirs	83.5
Airports	60.3
Railroads	60.1
Bridges	51.7
Educational facilities	49.0
Mass transit	37.2
Waterways	32.5
Locks	15.0
Prisons	7.0
Ports	3.7
Post offices	3.0
TOTAL	$3031.1

Adapted with permission of The Associated General Contractors of America, Washington, D.C., from "Infra-structure," *Constructor*, Vol. LXV, No. 5, May, 1983, p. 37.

INFORMATION SHEET

B. Repair and maintenance of the infrastructure will stimulate the economy by producing jobs (Table 2)

(NOTE: Labor requirements vividly illustrate how infrastructure repair and maintenance will affect job opportunities in future years. The Bureau of Labor Statistics estimates that 2.4 million additional workers will be required by 1990. Presently, existing training programs can be expected to provide only about 600,000 workers, leaving a shortage of 1.8 million skilled workers by 1990.)

EXAMPLE:

TABLE 2: New workers needed yearly

Worker	Number
Laborers	49,000
Highway construction workers	38,000
Equipment operators	36,000
Bricklayers	24,000
Plumbers and pipefitters	20,000

Source: Bureau of Labor Statistics

AMERICA'S INFRASTRUCTURE
UNIT II

ASSIGNMENT SHEET #1 — CONDUCT A SURVEY OF SPECIFIC INFRASTRUCTURE REPAIR NEEDS IN YOUR COMMUNITY

NAME ______________________ SCORE __________

The need for infrastructure rebuilding and maintenance is evident in many of the nation's communities. Often, these needs go unnoticed by the general public. Conduct a survey of local building, municipal, heavy industrial, and highway infrastructure facilities in your community.

Building infrastructure

Location ______________________

Specific need ______________________

____

____

Municipal infrastructure

Location ______________________

Specific need ______________________

____

____

Heavy industrial infrastructure

Location ______________________

Specific need ______________________

____

____

Highway infrastructure

Location ______________________

Specific need ______________________

____

____

AMERICA'S INFRASTRUCTURE
UNIT II

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1 — Evaluated to the satisfaction of the instructor

AMERICA'S INFRASTRUCTURE
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Define *infrastructure.*

   Infrastructure — ______________________________

   ____

   ____

   ____

2. Name general classes of infrastructures.

   a. ______________________________

   b. ______________________________

   c. ______________________________

   d. ______________________________

3. Select from the following list the purposes of the infrastructure. Write an "X" in the blank before each correct answer.

   _____a. To promote public health and safety

   _____b. To provide transportation of goods and services

   _____c. To improve the appearance of the countryside

   _____d. To aid in national defense

   _____e. To improve quality of life and standard of living

   _____f. To strengthen national economy

   _____g. To produce energy

4. Discuss the present condition of the nation's infrastructure.

   ____

   ____

   ____

   ____

AMERICA'S INFRASTRUCTURE
UNIT II

ANSWERS TO TEST

1. Infrastructure — System of public and private facilities that provides for delivery of essential services to sustain a minimum standard of living

2. a. Building infrastructures
   b. Municipal utilities infrastructures
   c. Heavy industrial infrastructures
   d. Highway infrastructures

3. a, b, d, e, f, g

4. Discussion should include the following.

   a. The nation's infrastructure is greatly deteriorated and in need of immediate costly repairs

   b. Repair and maintenance of the infrastructure will stimulate the economy by producing jobs

INDUSTRY ORIENTATION
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss concrete-related job opportunities and be able to apply for a job. The student will show this ability by completing assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. List levels of training for concrete-related jobs.
2. List job opportunities open to skilled concrete masons.
3. List major subskills involved in the concrete masonry trade.
4. Select from a list personal attributes or attitudes that an employer looks for in an employee.
5. List documents that an applicant may need to prepare when applying for a job.
6. Write a résumé.
7. Write a letter of application.
8. Complete an employment application.
9. Make an interview appointment by telephone for a concrete masonry job.
10. Write a follow-up letter or make a follow-up telephone call after interviewing for a concrete masonry job.
11. Complete a W-4 form.

INDUSTRY ORIENTATION
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

A. Objective sheet

B. Suggested activities

C. Information sheet

D. Assignment sheets

1. Assignment Sheet #1 — Complete a Personal-Information Sheet
2. Assignment Sheet #2 — Write a Résumé
3. Assignment Sheet #3 — Write a Letter of Application
4. Assignment Sheet #4 — Complete an Employment Application
5. Assignment Sheet #5 — Make an Interview Appointment by Telephone for a Concrete Masonry Job
6. Assignment Sheet #6 — Practice Interview Questions
7. Assignment Sheet #7 — Write a Follow-Up Letter or Make a Follow-Up Telephone Call After Interviewing for a Concrete Masonry Job
8. Assignment Sheet #8 — Compare Job Opportunities
9. Assignment Sheet #9 — Complete a W-4 Form

E. Answers to assignment sheets

F. Test

G. Answers to test

II. Instructor's guide

A. Obtain materials to supplement unit.

1. Films

(NOTE: The following films are available on a free-loan basis to Oklahoma teachers. Oklahoma teachers may order the films from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074. Out-of-state teachers must order from the addresses accompanying the films.)

SUGGESTED ACTIVITIES

a. *Getting a Job Is a Job*. Color, 20 minutes, Dibie-Dash Productions, Inc., 1966. Available from Dibie-Dash Productions, Inc., 4949 Hollywood Boulevard, Suite 208, Hollywood, California 90027.

(NOTE: This film discusses self-analysis, data sheets, and job sources.)

b. *Your Job: Applying for It*. Color, 13 minutes 30 seconds, Coronet Films, 1968. Available from Coronet Films, 65 East South Water Street, Chicago, Illinois 60601.

(NOTE: This film discusses appearance, leads, and perseverance.)

c. *Your Job: Finding the Right One*. Color, 13 minutes 30 seconds, Coronet Films, 1968. Available from Coronet Films, 65 East South Water Street, Chicago, Illinois 60601.

(NOTE: This film discusses a plan of action for job hunting.)

d. *Job Interview: I Guess I Got the Job*. Color, 13 minutes, McGraw-Hill. Available from McGraw-Hill Films, 110 Fifteenth Street, Del Mar, California 92014.

(NOTE: Through flashbacks, this film views approaches of two applicants for a job.)

e. *Get the Job: Line Up Your Interview*. Color, 11 minutes, Coronet Films, 1976. Available from Coronet Films, 65 East South Water Street, Chicago, Illinois 60601.

(NOTE: This film reviews how to write a résumé, choose a job objective, write a letter, and get a job.)

f. *Interview: Ready or Not*. Color, 24 minutes, Churchill Films, 1975. Available from Churchill Films, 622 North Robertson Boulevard, Los Angeles, California 90069.

(NOTE: This film explores the importance of a good self-concept during a job interview.)

2. Films and teaching kit—*Critical Steps of Job Interviewing*

(NOTE: This kit consists of a 16-mm film, five cassettes, and programmed learning notebooks. It is available for purchase from Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.)

SUGGESTED ACTIVITIES

3. Pamphlets

   a. *How to Get and Hold the Right Job*

   b. *How to Prepare Yourself for Job Interviews*

   c. *How to "Sell Yourself" to an Employer*

   (NOTE: All the above pamphlets are available from the nearest Oklahoma state employment service office.)

   d. *Appointment with Tomorrow*. Available from Vaseco, Inc., 2301 Classen Boulevard, P.O. Box 60274, Oklahoma City, Oklahoma 73106.

   e. *How Not to Blow a Job Interview*. Pamphlet available free from Army Reserve recruiter. U.S. Government Printing Office, 1978.

   f. *Making the Most of Your Job Interview*. Pamphlet available free from New York Life Insurance Company, 51 Madison Avenue, New York, New York 10010.

4. Competency profiles

   (NOTE: Competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone (202) 393-2040.)

B. Introduce the unit by discussing the variety of jobs available in the concrete masonry industry, emphasizing those that require skills taught in this course.

   SUGGESTIONS:

   - Make a bulletin-board display with ads and job notices for concrete-related openings; also include Department of Labor or other agency forecasts for employment needs within the industry for the next few years.

   - Make available books that describe various jobs in the concrete trade.

   - Obtain current statistics for your area or state on expenditures for construction, building permits, and so forth.

C. Provide students with objective sheet.

D. Discuss unit and specific objectives, emphasizing how each objective relates to the course goal of qualifying the student for employment within the industry.

E. Provide students with information and assignment sheets.

SUGGESTED ACTIVITIES

F. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to acquaint students with the levels of training available in the trade.

   SUGGESTIONS:

   - Relate the levels of training listed in the information sheet to specific concrete-related occupations.
   - Provide students with brochures and pamphlets from various types of concrete training programs, such as those from colleges.
   - Invite representatives from agencies involved in concrete training to discuss their programs with the class. You may wish to take the class to some of the agencies so that students may view the training in progress.

2. Use Information Sheet, Sections II and III, to discuss job opportunities available in the concrete trade and the major subskills involved in the trade.

   SUGGESTIONS:

   - Emphasize those specialties that are prevalent in your area and those for which your program is most tailored.
   - Discuss the particular skills and tasks required for the specialities in which the students are particularly interested.
   - Invite workers from various concrete jobs to talk to the class about the kinds of work they do and what they like and do not like about their jobs.

3. Use Information Sheet, Section IV, as an outline for discussing traits that an employer looks for in an employee.

   SUGGESTIONS:

   - Emphasize that the traits listed in Section IV are helpful to any worker, not just those in concrete-related fields; relate the traits to specific actions and attitudes for concrete masons.

     EXAMPLES: A good concrete mason should have a good set of tools and use and care for those tools properly.

     A good worker realizes that there is always more to learn and ways to improve; a good concrete mason never tries to hide weaknesses in skills or knowledge.

SUGGESTED ACTIVITIES

A good concrete mason observes all safety rules, even if some of them seem stupid, because the worker realizes that there are sound reasons for each rule.

A good concrete mason is interested in doing a good job and takes pride in his or her work.

- Stress to the students that the traits listed in Section IV will aid them during their training in this program and in dealing with life's situations in general.
- Invite appropriate employers to the class to discuss the traits that they look for in potential employees and how they go about determining whether job applicants have those traits.

4. Review Information Sheet, Section V, and use it as an introduction to the hiring process; discuss the hiring process and the documents that may be required in obtaining a job.

SUGGESTIONS:

- Use Assignment Sheets #2, #3, #4, and #7 to reinforce proper format for résumé, letter of application, application form, and follow-up.
- Use Assignment Sheets #1 and #9 to allow students to practice completing forms. Emphasize the need for accuracy and neatness, and try to overcome any fears in students who are intimidated by forms.
- Use Assignment Sheet #5 to allow students to practice making an interview appointment by telephone. Stress that this call is the first contact an applicant may have with the firm.
- Take students to a state or private employment agency and allow the agency staff to explain their functions and services.
- Use the films and other supplements mentioned in this section to expand the information and assignment sheets.
- Repeat Assignment Sheet #6 or similar interviewing role-plays in a variety of ways to allow the students to gain the most benefits.

  EXAMPLES: Videotape the interviews and allow the students to watch themselves; invite people with hiring responsibilities to act as the interviewer; allow the students to critique each other's interviews; change the questions.

- Use actual job notices and contact with actual employers to obtain the information necessary for Assignment Sheet #8; emphasize the many different factors besides salary that enter into an employment decision.

SUGGESTED ACTIVITIES

EXAMPLES: Benefits, travel requirements, advancement opportunities, the sense of achievement, the chance to develop new skills

- Invite recent graduates of your program to talk to the students about what they discovered upon entering the job market, about what surprised them, about how this training prepared them, and about how their attitudes may have changed since the time they first entered training.
- Review this unit at the end of the course, or when students are ready to enter on-the-job training.

G. Review information.

H. Give test.

I. Complete appropriate section of competency profiles.

III. Unit references

A. Hendrix, Laborn J. "Bud". *Heavy Equipment Operator Instructional Material, Vol. I.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1981.

B. Hendrix, Laborn J. "Bud". *Residential Carpentry.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center and The Associated General Contractors of America, 1985.

C. *Occupational Outlook Handbook*, Bulletin No. 1650. Washington, D.C.: U.S. Department of Labor Statistics, 1970-71.

D. Spann, Margaret. *English II.* Revised by Teresa Eacret, et al. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1983.

INDUSTRY ORIENTATION
UNIT III

INFORMATION SHEET

I. Levels of training for concrete-related jobs

A. Preparation

EXAMPLES: Vocational/technical, on-the-job, high school

B. Apprenticeship

EXAMPLES: Union, open shop

C. Post-secondary

EXAMPLES: College or university, technical school, business school

D. Upgrade

EXAMPLES: Open-shop training programs, union/management programs, special programs of materials and equipment companies, research and testing organization training, technical school training, industry certification programs (American Concrete Institute [ACI], Portland Cement Association [PCA] programs)

II. Job opportunities open to skilled concrete masons

A. Construction

EXAMPLES: Form building, concrete finishing, rubbing and sacking, installing base, installing terrazzo, installing speciality floors

B. Construction management

EXAMPLES: Contractor, estimator, supervisor, manager and planner

C. Training

EXAMPLES: Apprenticeship (union and open shop) instructor, vocational training center instructor, school shop teacher, equipment and materials instructor for workshops and seminars, writer

D. Concrete industry

EXAMPLES: Cement plants, ready-mix concrete plants, prefab and precast plants

INFORMATION SHEET

- E. Remodeling, restoration, and maintenance
- F. Materials and tool sales and service

III. Major subskills involved in the concrete masonry trade

- A. Blueprint reading
- B. Measuring and layout
- C. Estimating
- D. Tools' use
- E. Form building
- F. Placing, compacting, and rodding concrete
- G. Finishing concrete
- H. Rubbing and patching concrete
- I. Curing concrete
- J. Understanding material characteristics

  EXAMPLES: Additives, concrete ingredients
- K. Field testing

  EXAMPLES: Slump test, temperature test, weight test

IV. Personal attributes or attitudes that an employer looks for in an employee

- A. Enthusiasm and interest
- B. Dedication and dependability
- C. Alertness, quickness of mind
- D. Honesty and integrity
- E. Desire to work
- F. Knowledge and pride in the trade
- G. Desire to help others
- H. Desire to improve oneself
- I. Alertness to safety procedures

INFORMATION SHEET

V. Documents that an applicant may need to prepare when applying for a job

A. Résumé

(NOTE: A résumé is a brief summary of one's qualifications and work-related experiences.)

B. Letter of application

(NOTE: A letter of application states the applicant's interest in the position and shows the employer how the applicant will be useful to the trade. A letter of application usually includes a copy of the résumé.)

C. Job application

(NOTE: A job application is a form on which the applicant provides specific information about his or her personal history, job history, job experience, education, and references.)

D. Follow-up letter

(NOTE: A follow-up letter is mailed after the interview to thank the interviewer for the interview and to refresh the interviewer's memory.)

INDUSTRY ORIENTATION
UNIT III

ASSIGNMENT SHEET #1 — COMPLETE A PERSONAL-INFORMATION SHEET

NAME ______________________________ SCORE ______________

As you seek a job, you will be asked to complete various forms. You must always try to complete these forms neatly and accurately. Once you are hired, there will be other forms to fill out, usually including a form for personal information that may be necessary should the company need to contact your next of kin. Because of the jobs you will be performing in this program, such information will also be of use to your instructor.

Complete the following personal-information sheet, and then hand in the form to your instructor.

Name ______________________ Class ______________________

Home address ______________________________________

Home phone ______________________________________

Parents' (guardians') names ______________________________

Parents' (guardians') occupations ___________________________

____

____

____

Parents' (guardians') business phones _______________________

Place where parents (guardians') can be reached in case of an emergency ________

____

Family doctor ______________________________________

Shop courses you have taken _____________________________

____

Trade experience ___________________________________

____

Name of insurance company ______________________________

____

INDUSTRY ORIENTATION
UNIT III

ASSIGNMENT SHEET #2 — WRITE A RÉSUMÉ

NAME ________________________________ SCORE ______________

A good résumé should immediately give prospective employers a brief summary of your accomplishments, educational background, work experience, skills, and job objective.

Write a résumé, using accurate facts about yourself. Use the following information and the sample included in this assignment sheet as guides. It is not necessary to use the exact wording and outline form used on the sample, but it is necessary that your résumé be neat and balanced and contain all the information that might help you get a job.

Keep your résumé updated, and use it when you apply for jobs.

Guidelines for Writing a Résumé

- Inspect several résumé formats and choose one that best fits your needs, or use the example included in this assignment sheet as a guide.
- Type your résumé on 8 1/2-by-11-inch white paper. Try not to exceed one page, but attempt to fill the page.
- Spell correctly. Many employers will not consider persons whose résumés include misspelled words.
- Put your name prominently at the center top or in the upper left-hand corner. Beneath your name, give full street address, city, state, ZIP code, telephone number with area code, and a number where messages can be accepted.

  (NOTE: You may want to leave space to fill in your address on a printed résumé if you expect to change addresses.)
- Do not include birthplace, age, health, height, weight, sex, marital status, photograph, salary, or reasons for leaving previous job. Avoid giving religious and political affiliations.

  (NOTE: In general, the more information you are willing to share the better; however, the whole point of the résumé is to interest employers in meeting you. The above information may or may not be asked during the interview. By not including this information, there is little or no chance for discrimination because of race, color, religion, sex, or national origin.)
- Describe your job objective or career goal briefly. Do not restrict yourself to a specific job.

ASSIGNMENT SHEET #2

- Describe your educational background, giving dates of enrollment, diplomas or degrees received, and names of schools attended. Include grade average (if favorable) and major course of study. If you include school grades, be sure that they are related to the jobs you have in mind.

  (NOTE: Applicants with less than one year of work experience should list education before work experience; with more than one year, put experience first. In résumé writing, accentuate the positive, eliminate the negative. If pertinent, mention additional courses, scholarships, or summer school.)

- List your past employment, starting with your most recent job. Carefully examine all of your jobs—including extracurricular activities. Concentrate on the skills; do not categorize "summer jobs."

  (NOTE: The list should include the name of the company, your job title, and your major duties. The starting and termination dates for each job should also be listed.)

- List skills useful to the job. Remember, you have to prove your value to the business, especially if you have little experience.

  (NOTE: Use active verbs to indicate the specific tasks you performed, e.g. *built, assisted, operated.*)

- Include the following information if it is relevant and if there is enough space: hobbies and interests, extracurricular activities, clubs, and awards you have received.

- Ask at least three persons to serve as your references; ask yourself the kinds of recommendations they will give you.

  EXAMPLES: Business references (previous employers and co-workers), school references (teachers), character references (minister, rabbi, neighbor who knows you well)

  (NOTE: Avoid listing relatives unless you have actually worked for them on a salaried basis. Include addresses, titles, and phone numbers so that the prospective employers can contact your references.)

- Write "CONFIDENTIAL" at the top of the résumé if you do not want your current employer to know that you are looking for employment.

- Have a local printer retype your résumé and reproduce several copies. Request white bond paper.

  (NOTE: The physical appearance of your résumé is *very* important. Avoid using ditto or carbon copies. Be sure to proofread the printer's work. Always take extra copies to the interview. Leave one copy of your résumé with the interviewer and use one as a reference when filling out the application form. You should also mail one résumé with your letter of application.)

ASSIGNMENT SHEET #2

Sample Résumé

RÉSUMÉ

Terry L. McKracken
774 East Adams Street
Anytown, Yourstate 77704
Phone: (800) 555-7779

September 3, 1986

Job Objective: Career in concrete

EDUCATION

1982-1986	Anytown High School, Anytown, Yourstate 77704 *Activities:* President of senior class *Career-related courses:* Algebra, two semesters; geometry, two semesters; industrial arts woodworking, two semesters
1984-1986	Progress Vo-Tech, Progressville, Yourstate 77802 *Activities:* President of VICA *Honors:* Concrete masonry contest, 1st place, state; 3rd place, national *Courses:* Vocational concrete masonry, two years (1080 hours); basic drafting, two semesters *Certificate:* Concrete masonry, four semesters *Grade average:* 3.5 on a 4.0 scale

WORK EXPERIENCE

1986—	Jones Construction Company, Progressville, Yourstate 77802 Work as concrete mason's helper; responsible for assisting with layout, forming sidewalks, forming driveways, forming curb and gutters, forming exterior steps, assisting with placing and finishing concrete, and assisting in curing concrete
1984-1986	Vocational concrete masonry class, Progressville, Yourstate 77802 As a student, built or assisted with all phases of construction, written reports, math and accounting skills, and collection responsibilities

REFERENCES

Mr. John Jones
Construction Supervisor
Jones Construction Company
Progressville, Yourstate 77802
(800) 555-9578

Mr. Sammy Brown
Vocational Concrete Masonry Instructor
Progress Vo-Tech
Progressville, Yourstate 77802
(800) 555-0289

Ms. Jerry Smith
Youth Director
Parkview Church
711 Fellowship Circle
Anytown, Yourstate 77704
(800) 555-4307

INDUSTRY ORIENTATION
UNIT III

ASSIGNMENT SHEET #3 — WRITE A LETTER OF APPLICATION

NAME ______________________________ SCORE ______________

The application letter is a sales technique to tell the employer how your abilities will be useful to the business. While the résumé gives general background information, the letter of application should specify your qualifications. Not all jobs require formal applications and interviews, but there are an increasing number of companies using these hiring techniques.

Cut a help-wanted ad for a concrete mason's job from the classified-ad section of your local newspaper. Write an application letter to accompany the résumé you prepared in Assignment Sheet #2. Use as guides the following information and the sample letter at the end of the assignment sheet.

Guidelines for Writing a Letter of Application

Use acceptable form and appearance

- Type or write neatly
- Write on only one side of the paper
- Avoid smudges and typographical errors
- Use 8 1/2-by-11-inch white bond paper, not personal or fancy paper
- Spell, capitalize, and punctuate correctly
- Include employer's full name, title, and address
- Include your full name and address with ZIP code
- Retain a copy for further reference

Include proper information

- Write to a specific person

  (NOTE: Find out the name and the correct title of the person with hiring responsibility for the job that interests you. When in doubt, write to the top person who will refer your résumé to the right party. Use "To Whom It May Concern" if answering a blind ad.)

- Avoid excessive use of the pronoun "I"

ASSIGNMENT SHEET #3

- Be brief

  —Do not repeat all information that is in the résumé

  —Avoid needless details

  —Cover all points requested in the advertisement in exactly the order in which they were asked

  (NOTE: Some prospective employers make a point of testing the applicant's ability to follow directions.)

- State the position for which you are applying
- State the reason(s) for your interest in the job

  (NOTE: Employers look for people who want future advancement opportunities rather than just a paycheck.)

- Refer briefly to the main points in the attached résumé
- Mention that persons listed on the résumé have given their permission to serve as references
- Request an interview at the employer's convenience

  —Tell where you can be reached

  —Enclose a self-addressed envelope and your résumé

  —Say that you will telephone next week

End the letter properly

(NOTE: "Sincerely" or "Very truly yours" is appropriate.)

Use your permanent address for the return address

Staple the letter to the résumé: they may be circulated to several departments and could become separated

A week later, follow up and telephone for an appointment

(NOTE: Do not be surprised if your résumé has been referred to another department. Remember, the company is in business, and you may not get immediate attention, especially if you sent a letter in response to a blind ad. Be persistent until you reach the right person, and then ask for a convenient date to set up an interview.)

Keep in touch regarding possible openings now and in the future

(NOTE: The job hunt may take several weeks or even months. It is important to keep your prospects active without being a nuisance.)

ASSIGNMENT SHEET #3

Sample Letter of Application

774 East Adams Street
Anytown, Yourstate 77704
September 3, 1986

Mr. John Jones
Personnel Director
Jones Construction Company
Box 19
Progressville, Yourstate 77802

Dear Mr. Jones:

Please consider me for the job of concrete mason apprentice that you advertised in the *Daily Chronicle*.

The skills I have learned in my high school vocational concrete masonry course should qualify me for this job. I have had experience in all of the basic skills required in construction, including the safe use of power tools.

I graduated from high school in August, and I would like to work as a concrete mason. A more complete description of my qualifications is given in the enclosed résumé.

I would appreciate the opportunity to come and talk over this job opportunity at your convenience. I can be reached by telephone at (800) 555-7779 after 3:30 or at the above address.

Sincerely yours,

Terry McKracken
Terry McKracken

Enclosure

INDUSTRY ORIENTATION
UNIT III

ASSIGNMENT SHEET #4 — COMPLETE AN EMPLOYMENT APPLICATION

NAME ______________________________ SCORE ______________

This employment application will give you the opportunity to see what an application looks like and give you a chance to fill one out before you actually apply for a position.

Complete the following application, using the guidelines below and information about yourself from your résumé.

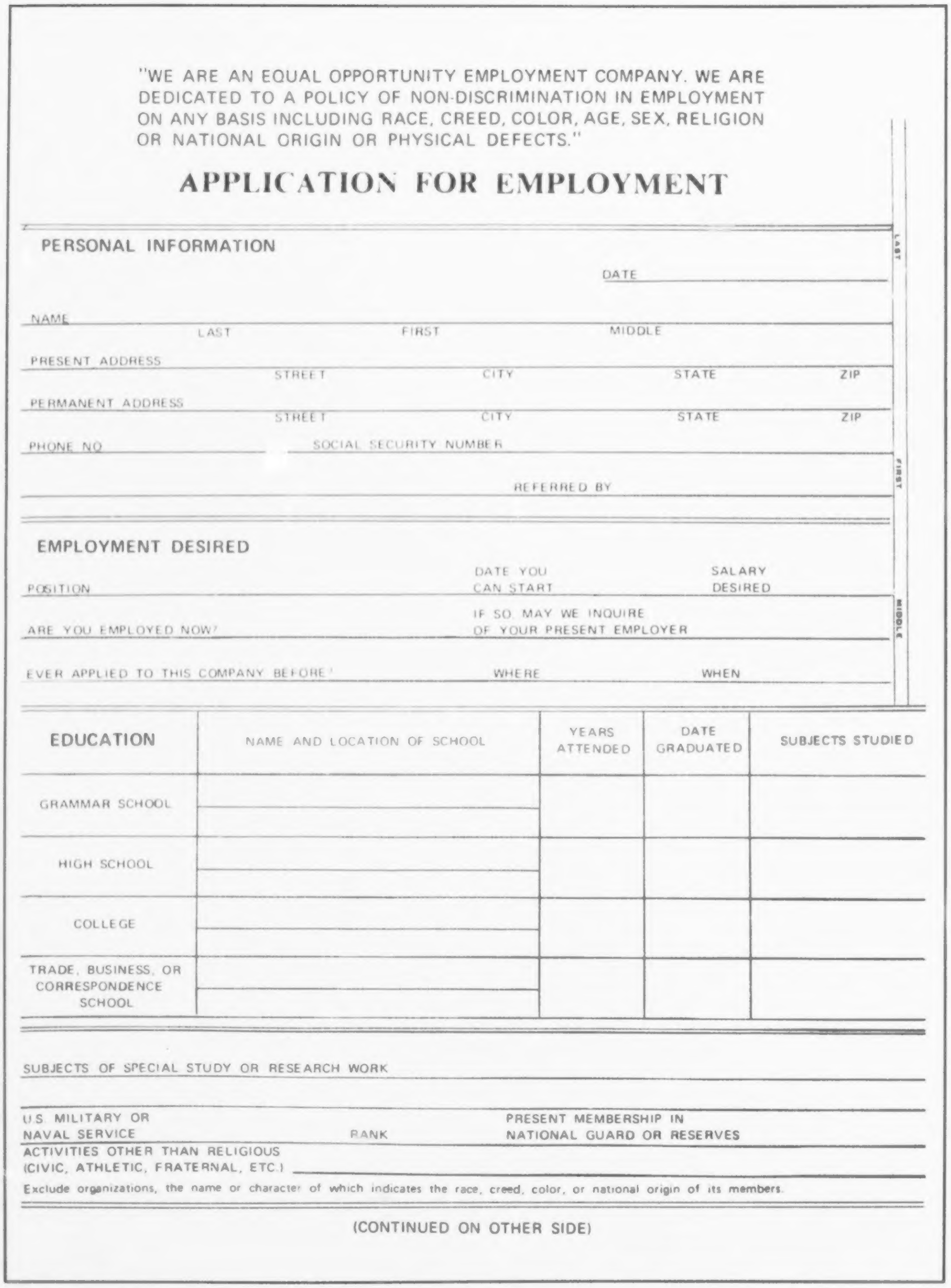
(NOTE: Although each business uses its own form, general rules of preparation apply to any form.)

Guidelines for Completing an Employment Application

- Be prepared
  - —Take a good ink pen
  - —Take copies of résumé
- Look over the entire application before starting to write; do not hurry
- Follow directions
  - —Note whether information is to be printed or written
  - —Carry out all directions
- Write clearly, neatly, and legibly
- Answer briefly
- Be honest
- Answer all questions completely

  (NOTE: If questions do not apply to you, write "Not Applicable" or "N/A" in the space to show that you did not overlook the question.)
- Recheck application when finished
- Avoid crossing out and erasing
- Use the word "open" for question about minimum salary because most employers pay standardized rates and will not negotiate on salary

ASSIGNMENT SHEET #4



"WE ARE AN EQUAL OPPORTUNITY EMPLOYMENT COMPANY. WE ARE DEDICATED TO A POLICY OF NON-DISCRIMINATION IN EMPLOYMENT ON ANY BASIS INCLUDING RACE, CREED, COLOR, AGE, SEX, RELIGION OR NATIONAL ORIGIN OR PHYSICAL DEFECTS."

APPLICATION FOR EMPLOYMENT

PERSONAL INFORMATION

DATE

NAME — LAST — FIRST — MIDDLE

PRESENT ADDRESS — STREET — CITY — STATE — ZIP

PERMANENT ADDRESS — STREET — CITY — STATE — ZIP

PHONE NO — SOCIAL SECURITY NUMBER

REFERRED BY

LAST

FIRST

MIDDLE

EMPLOYMENT DESIRED

POSITION — DATE YOU CAN START — SALARY DESIRED

ARE YOU EMPLOYED NOW? — IF SO MAY WE INQUIRE OF YOUR PRESENT EMPLOYER

EVER APPLIED TO THIS COMPANY BEFORE? — WHERE — WHEN

EDUCATION	NAME AND LOCATION OF SCHOOL	YEARS ATTENDED	DATE GRADUATED	SUBJECTS STUDIED
GRAMMAR SCHOOL				
HIGH SCHOOL				
COLLEGE				
TRADE, BUSINESS, OR CORRESPONDENCE SCHOOL				

SUBJECTS OF SPECIAL STUDY OR RESEARCH WORK

U.S. MILITARY OR NAVAL SERVICE — RANK — PRESENT MEMBERSHIP IN NATIONAL GUARD OR RESERVES

ACTIVITIES OTHER THAN RELIGIOUS (CIVIC, ATHLETIC, FRATERNAL, ETC.)

Exclude organizations, the name or character of which indicates the race, creed, color, or national origin of its members.

(CONTINUED ON OTHER SIDE)

ASSIGNMENT SHEET #4

FORMER EMPLOYERS (LIST BELOW LAST FOUR EMPLOYERS, STARTING WITH LAST ONE FIRST.)

DATE MONTH & YEAR	NAME AND ADDRESS OF EMPLOYER	SALARY	POSITION	REASON FOR LEAVING
FROM TO				
FROM TO				
FROM TO				
FROM TO				

REFERENCES: Give below the names of two persons not related to you, whom you have known at least one year.

NAME	ADDRESS	BUSINESS	YEARS ACQUAINTED
1			
2			

PHYSICAL RECORD:
List any physical defects

WERE YOU EVER INJURED? GIVE DETAILS

HAVE YOU ANY DEFECTS IN HEARING? IN VISION? IN SPEECH?

IN CASE OF EMERGENCY NOTIFY
NAME ADDRESS PHONE NO.

I AUTHORIZE INVESTIGATION OF ALL STATEMENTS CONTAINED IN THIS APPLICATION. I UNDERSTAND THAT MISREPRESENTATION OR OMISSION OF FACTS CALLED FOR IS CAUSE FOR DISMISSAL. FURTHER, I UNDERSTAND AND AGREE THAT MY EMPLOYMENT IS FOR NO DEFINITE PERIOD AND MAY, REGARDLESS OF THE DATE OF PAYMENT OF MY WAGES AND SALARY, BE TERMINATED AT ANY TIME WITHOUT ANY PREVIOUS NOTICE.

DATE SIGNATURE

DO NOT WRITE BELOW THIS LINE

TO BE COMPLETED DAY EMPLOYMENT BEGINS DATE

HEIGHT WEIGHT AGE DATE OF BIRTH

SINGLE MARRIED WIDOWED CITIZEN U.S.A. SEX

THE ABOVE INFORMATION NEEDED FOR PENSION, HOSPITALIZATION, INSURANCE, ETC., AND NOT FOR HIRING PURPOSES

INTERVIEWED BY DATE REMARKS

NEATNESS		CHARACTER	
PERSONALITY		ABILITY	

HIRED FOR DEPT. POSITION WILL REPORT SALARY WAGES

APPROVED: 1. 2. 3.
EMPLOYMENT MANAGER DEPT. HEAD GENERAL MANAGER

INDUSTRY ORIENTATION
UNIT III

ASSIGNMENT SHEET #5 — MAKE AN INTERVIEW APPOINTMENT BY TELEPHONE FOR A CONCRETE MASONRY JOB

NAME ______________________________ SCORE ______________

Making an appointment by telephone accomplishes two things. First, it shows that you are interested in saving the employer's time. Second, it shows that you are thoughtful enough to ask the best time for you to see the employer.

PART I

Read the following steps and reminders for making an interview appointment by telephone.

Guidelines for Making an Interview Appointment by Telephone

Steps in making an appointment

- Plan what you are going to say before you call
- State your name and reason for calling

  EXAMPLE: "Hello, this is Terry McKracken. I am calling about your ad for a concrete mason that appeared in last night's paper. May I make an appointment for an interview?"

- Ask when would be the best time for you to come for the interview, and ask for the name of the interviewer
- Record the day, time, and place of the interview, and the name of the interviewer
- Ask if you should pick up an application form or if they would like to send it to you before the interview
- Thank the receptionist for the help

Things to remember

- Remember that this call is the first contact you may have with the firm; make that first impression a good one
- Keep the receptionist on your side; the receptionist is there to help you
- Do not ask over the telephone how much the job pays
- Be polite and courteous

ASSIGNMENT SHEET #5

PART II

Now that you have read about the correct way to arrange for a job interview, role-play a situation in which you make an interview appointment for a concrete masonry job by telephone. Use the checklist below to evaluate your performance.

	Yes	No
Was prepared before calling?	☐	☐
Did not have to stammer to find the right words?	☐	☐
Immediately identified self?	☐	☐
Immediately stated reasons for calling?	☐	☐
Asked the best time for an appointment with employer?	☐	☐
Was courteous and friendly?	☐	☐
Asked about picking up application form or having application form sent prior to interview?	☐	☐
Thanked the receptionist?	☐	☐
Made record of the interview date, hour, and place, and of interviewer's name?	☐	☐

INDUSTRY ORIENTATION
UNIT III

ASSIGNMENT SHEET #6 — PRACTICE INTERVIEW QUESTIONS

NAME ______________________________ SCORE ______________

An employer may not legally ask questions about an applicant's personal life. In fact, it is illegal for an employer to ask what your maiden name is if you are a female applicant; what your marital status is; who lives with you; what church you attend or who your spiritual leader is; how many children you have, their ages, or who will care for them while you are at work; whether you rent or own your residence; whether you have ever had your wages garnisheed; or whether you have ever been arrested. However, many interviewers, particularly those in small businesses, sometimes ask such questions anyway. Whether or not you choose to answer such questions depends on how much you want the job.

The following questions are some that might be asked on an application form or during a job interview. Write an answer for each question. Keep this assignment sheet to review before going to an interview.

A. Why did you leave your previous job?

(NOTE: Try to be positive in stating your reasons for leaving a former job. Do not downgrade your previous employer.)

____

B. What did you like best about your job?

____

C. Are you in good health? ______________________

D. Do you intend to make this work your career? ______________________

E. What are some of your special abilities?

____

____

F. What equipment do you operate?

____

____

G. How would you rate your training for this job? Very good? Fair? Why?

____

ASSIGNMENT SHEET #6

H. What personal characteristics do you think are needed to succeed in your vocation?

I. At what salary do you expect to start?

J. How could you contribute to our organization?

K. Why should we hire you?

L. Tell us about your family and any plans for marriage or further education.

(NOTE: Remember, legally you do not have to answer this question. However, it is a good idea to have an answer.)

M. Have you applied for any other job?

N. Do you have any military obligations to fulfill?

O. Would you be able to work Saturdays and Sundays?

P. Does negative criticism disturb you?

ASSIGNMENT SHEET #6

Q. Would you be willing to relocate?

R. What size city do you prefer? Why?

S. Define *cooperation.*

T. How do you feel about working overtime?

REMEMBER: You never get a second chance to make a good first impression. Getting a job is a job!

INDUSTRY ORIENTATION
UNIT III

ASSIGNMENT SHEET #7 — WRITE A FOLLOW-UP LETTER OR MAKE A FOLLOW-UP TELEPHONE CALL AFTER INTERVIEWING FOR A CONCRETE MASONRY JOB

NAME ______________________________ SCORE ______________

It is sometimes helpful to return to a business and check again on possible job openings. This is often done about a week after the first interview. This short, casual visit accomplishes two things. It helps the interviewer remember you, and it shows that you have a sincere interest in working for that company.

It is not always possible to have this type of informal atmosphere when applying for a job. However, it is always proper to send a follow-up letter or to make a follow-up telephone call.

PART I

Write a follow-up letter thanking the employer for the interview. Use any form you wish, or follow the format of the sample follow-up letter included in this assignment sheet. Use the information below as a guide.

Guidelines for Writing a Follow-Up Letter

- Make sure that your letter meets the following standards
  - —Typed or written perfectly
  - —Clean, neat, and attractively arranged on the page
  - —Free of spelling, punctuation, and grammatical errors
  - —Sent within a day or two after the interview
- Include the following points in your follow-up letter
  - —Expression of appreciation for interviewer's time and interest
  - —Summary of your qualifications and interest in position
  - —Your name, address, and telephone number (to make it easier for your employer to contact you)
- Make this last bid for the job a prime example of your excellent work habits; write a clean, neat, and well-worded letter

ASSIGNMENT SHEET #7

Sample Follow-Up Letter

774 East Adams Street
Anytown, Yourstate 77704
September 3, 1986

Mr. John Jones
Personnel Director
Jones Construction Company
Box 19
Progressville, Yourstate 77802

Dear Mr. Jones:

Thank you for interviewing me for the job of a concrete mason with your company. I feel that working for Jones Construction Company would be enjoyable and that I could do the general concrete work that the job requires. I hope that I will have the opportunity to prove my worth.

The application form you gave me is enclosed.

I will be available for work October 15. You may call me at my home after 3:30 P.M. The number is (800) 555-7779.

Sincerely yours,

Terry McKracken

Terry McKracken

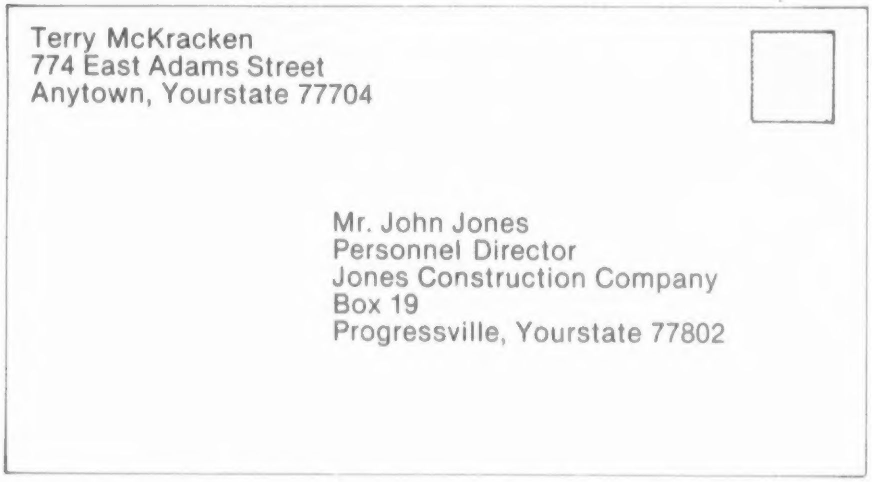
Enclosure

ASSIGNMENT SHEET #7

PART II

Address a legal-sized envelope and insert folded follow-up letter.

A. Type the address on the envelope exactly the same as the inside address of the letter

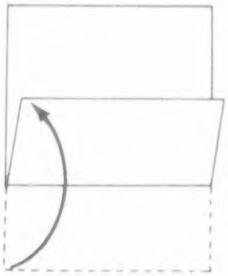


Terry McKracken
774 East Adams Street
Anytown, Yourstate 77704

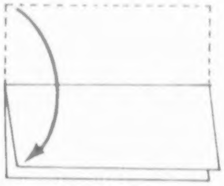
Mr. John Jones
Personnel Director
Jones Construction Company
Box 19
Progressville, Yourstate 77802

B. Fold letter

1. Fold slightly less than one-third of letter toward top

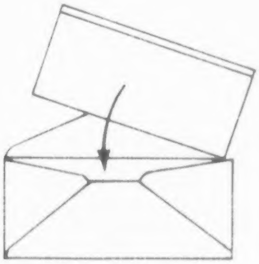


2. Fold down the top of letter to within 1/2 inch of bottom fold



ASSIGNMENT SHEET #7

C. Insert letter into envelope, with last crease toward bottom of envelope



PART III

Role-play a follow-up telephone call. Make sure to include the following information: your name, the date of your interview, and the position for which you were interviewed.

A. Ask whether a decision has been made

EXAMPLES: Incorrect: "Hello, Mr. Jones. This is Terry McKracken. You told me you would let me know about the job, but I haven't heard anything from you. Why haven't you called me?"

Incorrect: "This is Terry McKracken. Did I get the job?"

Correct: "Hello, Mr. Jones. This is Terry McKracken. I interviewed with you on September 15 for the position of a concrete mason. Have you made a decision on my application yet?"

B. If someone else has already been hired, thank the interviewer for considering you, but express continued interest in working for the company

EXAMPLES: Incorrect: "Oh well, that's my luck. Thanks anyway."

Incorrect: "I didn't want to work for your company anyway."

Correct: "I am sorry I was not hired. Thank you for considering my application. I am still interested in working for the company and would appreciate your keeping my application on file."

INDUSTRY ORIENTATION
UNIT III

ASSIGNMENT SHEET #8 — COMPARE JOB OPPORTUNITIES

NAME ______________________________ SCORE ______________

When you are offered a job, there are many factors to weigh before taking the position. Some of these factors include take-home pay, benefits that accompany the job, actual cost of being at work each day, how satisfying the job would be, and how the job would meet your needs and aspirations.

PART I

There are certain questions that you should ask yourself when weighing job opportunities. Part I of this assignment sheet outlines some of those questions. Using information from jobs for which you have applied or those in which you are interested, complete the following activities.

A. What benefits besides pay do I get from the job?

Some benefits associated with working are not always visible. Often some of these overlooked benefits are paid for in part by your employer. Obtain information about the benefits in the jobs you are considering. Be sure to note any benefits that must be paid for in part or completely by the employee. At the time of the interview, or when considering a position, ask about the following benefits:

1. Employer's contributions for your protection that may include
   - Health insurance
   - Unemployment compensation
   - Clothing and safety garments
   - Medical facilities and health tests
   - Pensions
   - Travel insurance (covering mishaps when traveling on business)
   - Educational programs or reimbursement for courses related to job
2. Sick leave with pay
3. Paid vacations and holidays

B. What is my take-home pay?

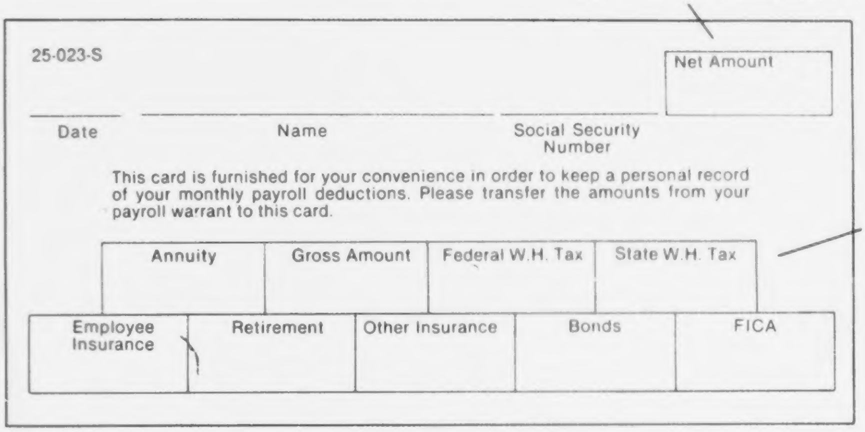
Salaries and wages are often quoted by employers as *gross earnings*. Gross earnings are used because tax deductions vary depending upon the number of dependents, the amount of earnings, and other information.

ASSIGNMENT SHEET #8

Optional benefits and deductions offered by an employer also differ. It is generally advisable to ask what programs are available, because such programs can affect the actual money you receive on payday.

Information about your earnings and withholdings is often recorded on a form such as the one shown below. Use the information about salary and payroll deductions provided by employers or by your instructor, along with tax information provided by your instructor, to determine take-home pay for the jobs you are considering.

NET PAY is the actual money you receive on payday after all required and optional deductions have been taken out.



25-023-S

Net Amount

Date ______ Name ______ Social Security Number ______

This card is furnished for your convenience in order to keep a personal record of your monthly payroll deductions. Please transfer the amounts from your payroll warrant to this card.

Annuity	Gross Amount	Federal W.H. Tax	State W.H. Tax

Employee Insurance	Retirement	Other Insurance	Bonds	FICA

Basic required deductions, federal tax, and social security

C. What will it cost to work at this job?

Frequently, the costs associated with being employed are overlooked. It may be of value to calculate estimated weekly expenses before making a decision about a job.

Estimate weekly expenses for

Transportation, gasoline (parking, bus fares) $______

Lunches (cost of food eaten away from home, including soft drinks and coffee) $______

Clothing (including cleaning) $______

Child care $______

Gifts for other employees $______

Special uniforms, materials, or equipment for job $______

Other $______

TOTAL $______

ASSIGNMENT SHEET #8

D. What is important to me in a job?

Take-home pay and benefits may be only part of what you want from a job. Think through other things you consider important in a job.

1. What have been some of your most rewarding job experiences? Why?

   a. ______________________________

   b. ______________________________

   c. ______________________________

2. Rate the following in order of what is important to you, with "1" being the most important.

   ______a. Job security (little chance you will be released from the job)

   ______b. Opportunity for advancement

   ______c. Recognition for your work

   ______d. Good wages

   ______e. Opportunity to learn and use your ideas

   ______f. Flexible working conditions

   ______g. Long vacations

   ______h. Pleasant working conditions

   ______i. Interesting work

   ______j. Friendly co-workers

   ______k. Other, such as______________________________

PART II

To reach a decision about whether you want the job or not, summarize the information you have gathered.

A. Would the job be satisfying to me? Why or why not?

____

ASSIGNMENT SHEET #8

B. What are the benefits that accompany the job?

____

____

C. How much will it actually cost to be at work each day?____________________

D. How would the job meet my needs and aspirations?

____

____

____

E. I estimate my take-home pay to be $____________________.

F. I estimate my expenses related to working to be $____________________.

G. I estimate my job benefits to be worth $____________________.

H. I would most enjoy the following about this job.

____

____

____

____

____

____

____

INDUSTRY ORIENTATION
UNIT III

ASSIGNMENT SHEET #9 — COMPLETE A W-4 FORM

NAME ____ SCORE ________________

The law requires that any working person must complete a W-4 form so that employers can withhold federal income tax from employees' pay. Your W-4 form remains in effect until you change it or, if you entered "Exempt" on line 6b, until February 15 of next year. By correctly completing this form, you can fit the amount of tax withheld from wages to your tax liability.

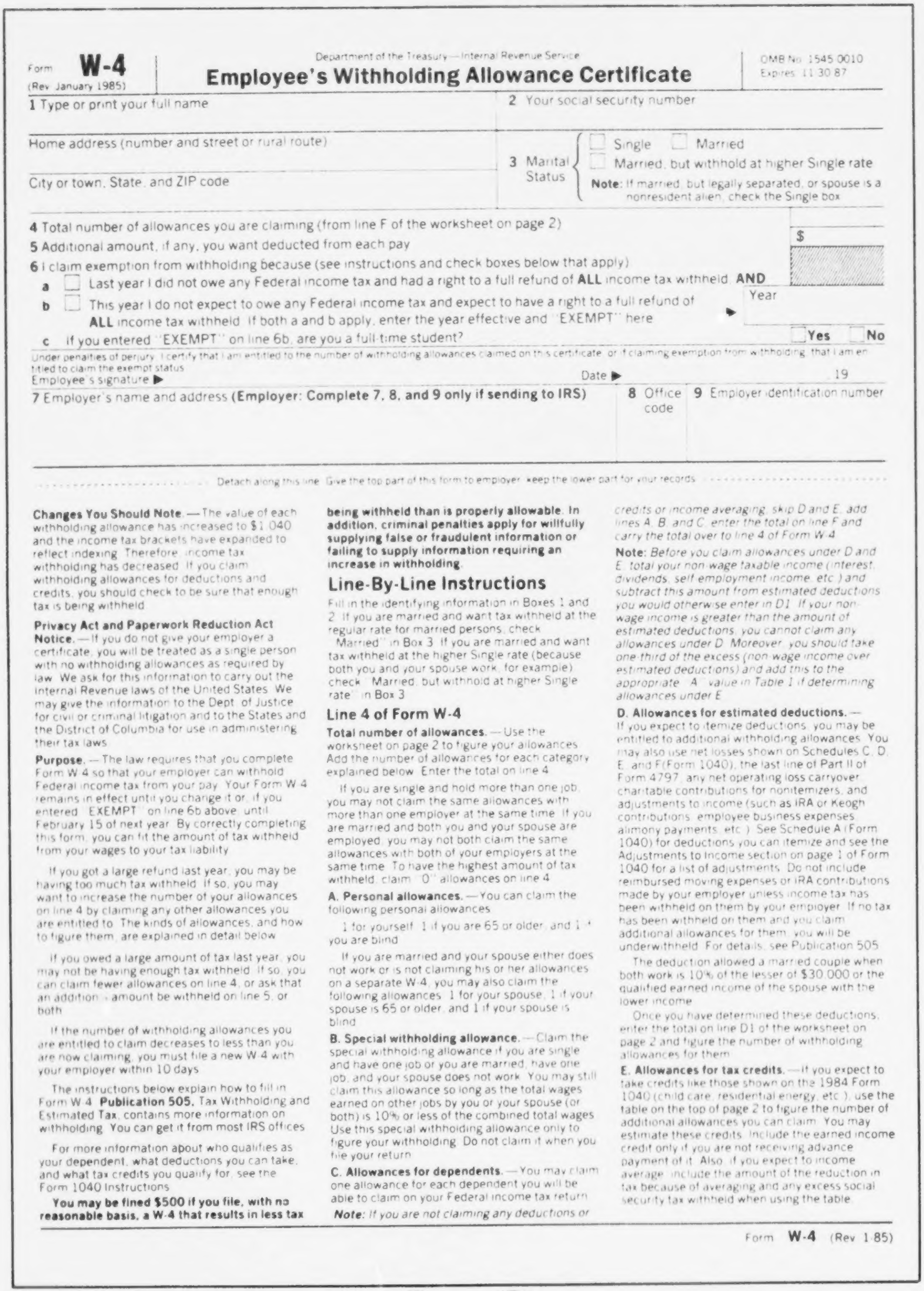
Complete the W-4 tax form on the next page, using the guidelines below and information about yourself.

Guidelines for Completing a W-4 Form

- Be prepared
- Follow directions
- Write or print clearly, neatly, and legibly
- Answer all questions honestly
- Include complete information
- Recheck form when finished
- Avoid crossing out and erasing
- Do not write in boxes #7, #8, and #9

When you are sure the form is correct and complete, detach at the perforated line and give the top part to your employer (instructor); keep the lower part for your records and information.

ASSIGNMENT SHEET #9



Form **W-4**
(Rev January 1985)

Department of the Treasury—Internal Revenue Service

Employee's Withholding Allowance Certificate

OMB No 1545 0010
Expires 11 30 87

1 Type or print your full name

2 Your social security number

Home address (number and street or rural route)

City or town, State, and ZIP code

3 Marital Status ☐ Single ☐ Married
☐ Married, but withhold at higher Single rate
Note: If married, but legally separated, or spouse is a nonresident alien, check the Single box

4 Total number of allowances you are claiming (from line F of the worksheet on page 2)

5 Additional amount, if any, you want deducted from each pay $

6 I claim exemption from withholding because (see instructions and check boxes below that apply)

a ☐ Last year I did not owe any Federal income tax and had a right to a full refund of **ALL** income tax withheld **AND**

b ☐ This year I do not expect to owe any Federal income tax and expect to have a right to a full refund of **ALL** income tax withheld If both a and b apply, enter the year effective and "EXEMPT" here ▶ Year

c If you entered "EXEMPT" on line 6b, are you a full-time student? ☐ **Yes** ☐ **No**

Under penalties of perjury, I certify that I am entitled to the number of withholding allowances claimed on this certificate, or if claiming exemption from withholding, that I am entitled to claim the exempt status

Employee's signature ▶ Date ▶ , 19

7 Employer's name and address **(Employer: Complete 7, 8, and 9 only if sending to IRS)**

8 Office code

9 Employer identification number

Detach along this line Give the top part of this form to employer keep the lower part for your records

Changes You Should Note.—The value of each withholding allowance has increased to $1,040 and the income tax brackets have expanded to reflect indexing Therefore, income tax withholding has decreased If you claim withholding allowances for deductions and credits, you should check to be sure that enough tax is being withheld

Privacy Act and Paperwork Reduction Act Notice.—If you do not give your employer a certificate, you will be treated as a single person with no withholding allowances as required by law We ask for this information to carry out the Internal Revenue laws of the United States We may give the information to the Dept of Justice for civil or criminal litigation and to the States and the District of Columbia for use in administering their tax laws

Purpose.—The law requires that you complete Form W-4 so that your employer can withhold Federal income tax from your pay Your Form W-4 remains in effect until you change it or, if you entered "EXEMPT" on line 6b above, until February 15 of next year By correctly completing this form, you can fit the amount of tax withheld from your wages to your tax liability

If you got a large refund last year, you may be having too much tax withheld If so, you may want to increase the number of your allowances on line 4 by claiming any other allowances you are entitled to The kinds of allowances, and how to figure them, are explained in detail below

If you owed a large amount of tax last year, you may not be having enough tax withheld If so, you can claim fewer allowances on line 4, or ask that an additional amount be withheld on line 5, or both

If the number of withholding allowances you are entitled to claim decreases to less than you are now claiming, you must file a new W-4 with your employer within 10 days

The instructions below explain how to fill in Form W-4 **Publication 505,** Tax Withholding and Estimated Tax, contains more information on withholding You can get it from most IRS offices

For more information about who qualifies as your dependent, what deductions you can take, and what tax credits you qualify for, see the Form 1040 Instructions

You may be fined $500 if you file, with no reasonable basis, a W-4 that results in less tax being withheld than is properly allowable. In addition, criminal penalties apply for willfully supplying false or fraudulent information or failing to supply information requiring an increase in withholding.

Line-By-Line Instructions

Fill in the identifying information in Boxes 1 and 2 If you are married and want tax withheld at the regular rate for married persons, check "Married" in Box 3 If you are married and want tax withheld at the higher Single rate (because both you and your spouse work, for example) check "Married, but withhold at higher Single rate" in Box 3

Line 4 of Form W-4

Total number of allowances.—Use the worksheet on page 2 to figure your allowances Add the number of allowances for each category explained below Enter the total on line 4

If you are single and hold more than one job, you may not claim the same allowances with more than one employer at the same time If you are married and both you and your spouse are employed, you may not both claim the same allowances with both of your employers at the same time To have the highest amount of tax withheld, claim "0" allowances on line 4

A. Personal allowances.—You can claim the following personal allowances

1 for yourself, 1 if you are 65 or older, and 1 if you are blind

If you are married and your spouse either does not work or is not claiming his or her allowances on a separate W-4, you may also claim the following allowances 1 for your spouse, 1 if your spouse is 65 or older, and 1 if your spouse is blind

B. Special withholding allowance.—Claim the special withholding allowance if you are single and have one job or you are married, have one job, and your spouse does not work You may still claim this allowance so long as the total wages earned on other jobs by you or your spouse (or both) is 10% or less of the combined total wages Use this special withholding allowance only to figure your withholding Do not claim it when you file your return

C. Allowances for dependents.—You may claim one allowance for each dependent you will be able to claim on your Federal income tax return

Note: *If you are not claiming any deductions or credits or income averaging, skip D and E, add lines A, B, and C, enter the total on line F and carry the total over to line 4 of Form W-4*

Note: *Before you claim allowances under D and E, total your non-wage taxable income (interest, dividends, self-employment income, etc) and subtract this amount from estimated deductions you would otherwise enter in D1 If your non-wage income is greater than the amount of estimated deductions, you cannot claim any allowances under D Moreover, you should take one-third of the excess (non-wage income over estimated deductions) and add this to the appropriate "A" value in Table 1 if determining allowances under E*

D. Allowances for estimated deductions.—If you expect to itemize deductions, you may be entitled to additional withholding allowances You may also use net losses shown on Schedules C, D, E, and F (Form 1040), the last line of Part II of Form 4797, any net operating loss carryover, charitable contributions for nonitemizers, and adjustments to income (such as IRA or Keogh contributions, employee business expenses, alimony payments, etc) See Schedule A (Form 1040) for deductions you can itemize and see the Adjustments to Income section on page 1 of Form 1040 for a list of adjustments Do not include reimbursed moving expenses or IRA contributions made by your employer unless income tax has been withheld on them by your employer If no tax has been withheld on them and you claim additional allowances for them, you will be underwithheld For details, see Publication 505

The deduction allowed a married couple when both work is 10% of the lesser of $30,000 or the qualified earned income of the spouse with the lower income

Once you have determined these deductions, enter the total on line D1 of the worksheet on page 2 and figure the number of withholding allowances for them

E. Allowances for tax credits.—If you expect to take credits like those shown on the 1984 Form 1040 (child care, residential energy, etc), use the table on the top of page 2 to figure the number of additional allowances you can claim You may estimate these credits Include the earned income credit only if you are not receiving advance payment of it Also, if you expect to income average, include the amount of the reduction in tax because of averaging and any excess social security tax withheld when using the table

Form **W-4** (Rev 1-85)

ASSIGNMENT SHEET #9

Line 5 of Form W-4

Additional amount, if any, you want deducted from each pay.—If you are not having enough tax withheld from your pay, you may ask your employer to withhold more by filling in an additional amount on line 5. Often, married couples, both of whom are working, and persons with two or more jobs need to have additional tax withheld. You may also need to have additional tax withheld because you have income other than wages, such as interest and dividends, capital gains, rents, alimony received, taxable social security benefits, etc. Estimate the amount you will be underwithheld and divide that amount by the number of pay periods [illegible]. Enter the additional amount you want [illegible] period on line 5.

Line 6 of Form W-4

Exemption from withholding.—[illegible] exemption from withholding [illegible] you did not owe any Federal income tax and had a right to a refund of all income tax withheld, and this year you do not expect to owe any Federal income tax and expect to have a right to a refund of all income tax withheld. If you qualify, check Boxes 6a and b, write the year exempt status is effective and "EXEMPT" on line 6c, and answer Yes or No to the question on line 6[illegible].

[illegible] exemption from withholding [illegible] next year, you must file a new W-4 with your employer on or before February 15 of next year. If you are not having Federal income tax withheld this year, but expect to have a tax [illegible] you [illegible] give your employer a new W-4 by December 1 of this year. [illegible] social security your [illegible] social security tax.

[illegible] employer must send to IRS any W-4 claiming more than 14 withholding allowances or claiming exemption from withholding if the wages are expected to usually exceed $200 a week. The employer [illegible] Boxes 7, 8, and 9 only on copies of the W-4 sent to IRS.

Table 1—For Figuring Your Withholding Allowances for Estimated Tax Credits and Income Averaging (Line E)

Estimated Salaries and Wages from All Sources	Single Employees		Head of Household Employees		Married Employees (When Spouse not Employed)		Married Employees (When Both Spouses Are Employed)	
	(A)	(B)	(A)	(B)	(A)	(B)	(A)	(B)
Under $15,000	$ 90	$160	$ 0	$160	$ [illegible]	$[illegible]	$ [illegible]	$130
15,000-25,000	120	260	0	290	[illegible]	[illegible]	310	180
25,001-35,000	160	320	0	320	[illegible]	[illegible]	[illegible]	230
35,001-45,000	240	390	0	390	[illegible]	[illegible]	[illegible]	260
45,001-55,000	610	390	0	390	[illegible]	[illegible]	[illegible]	320
55,001-65,000	1,260	390	110	390	[illegible]	[illegible]	[illegible]	350
Over 65,000	2,250	390	730	390	[illegible]	[illegible]	[illegible]	390

Worksheet to Figure Your Withholding Allowances To Be Entered on Line 4 of Form W-4

A Personal allowances ▶ A ____

B Special withholding allowance (not to exceed 1 allowance—see instructions on page [illegible]) ▶ B ____

C Allowances for dependents ▶ C ____

If you are not claiming any deductions or credits or income averaging, skip lines D and E.

D Allowances for estimated deductions

1 Enter the total amount of your estimated itemized deductions, alimony payments, [illegible] retirement contributions including IRA and Keogh (H.R. 10) plans, deduction for a married couple when both work, business losses including net operating loss carryovers, moving expenses, employee business expenses, penalty on early withdrawal of savings, and charitable contributions for nonitemizers for the year ▶ 1 $

2 If you do not plan to itemize deductions, enter $520 on line D2. If you plan to itemize, find your total estimated salaries and wages amount in the left column of the table below. [illegible] and wages of both spouses.) Read across to the right and find the amount from the column that applies to you. Enter that amount on line D2 ▶ 2 $

Estimated salaries and wages from all sources:	Single and Head of Household Employees (only one job)		Married Employees (one spouse working and one job only)		[illegible]	
Under $20,000	$2,800		$3,900		[illegible]	[illegible]
20,000-45,000	2,800		3,900		[illegible]	
45,001-60,000	8%	of estimated salaries and wages	3,900		[illegible]	
Over $60,000	10%		7%	of estimated salaries and wages	[illegible]	

3 Subtract line D2 from line D1 (But not less than zero) ▶ 3 $

4 Divide the amount on line D3 by $1,040 (increase any fraction to the next whole number) [illegible] ▶ D ____

E Allowances for tax credits and income averaging (use Table 1 above for figuring withholding allowances)

1 Enter tax credits, excess social security tax withheld, and tax reduction from income averaging $

2 Enter the column (A) amount from Table 1 for your salary range and filing status [illegible] However, enter 0 if you claim 1 or more allowances on line D4 $

3 Subtract line 2 from line 1 (If zero or less, do not complete lines 4 and 5) $

4 Find the column (B) amount from Table 1 for your salary range and filing status $

5 Divide line 3 by line 4. Increase any fraction to the next whole number. This is the [illegible] withholding allowances for tax credits and income averaging. Enter here ▶ E ____

Example: A taxpayer who expects to file a Federal income tax return as a single person estimates annual wages of $12,000 and tax credits of $650. The $12,000 falls in the wage bracket of under $15,000. The value in column (A) is $90. Subtracting this from the estimated credits of $650 leaves $560. The value in column (B) is $160. Dividing $560 by $160 gives 3.5. Since any fraction is increased to the next whole number, show 4 on line E.

F Total (add lines A through E). Enter total here and on line 4 of Form W-4 ▶ F ____

---

[1] If you earn 10% or less of your total wages from other jobs or one spouse earns 10% or less of the couple's combined total wages, you can use the "Single and Head of Household Employees (only one job)" or "Married Employees (one spouse working and one job only)" table, whichever is appropriate.

U.S. GOVERNMENT PRINTING OFFICE: [illegible]

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INDUSTRY ORIENTATION
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 — Completed to the satisfaction of the instructor

Assignment Sheet #2 — Completed to the satisfaction of the instructor

Assignment Sheet #3 — Completed to the satisfaction of the instructor

Assignment Sheet #4 — Completed to the satisfaction of the instructor

Assignment Sheet #5 — Completed to the satisfaction of the instructor

Assignment Sheet #6 — Completed to the satisfaction of the instructor

Assignment Sheet #7 — Completed to the satisfaction of the instructor

Assignment Sheet #8 — Completed to the satisfaction of the instructor

Assignment Sheet #9 — Completed to the satisfaction of the instructor

INDUSTRY ORIENTATION
UNIT III

TEST

NAME ______________________________ SCORE ______________

1. List three levels of training for concrete-related jobs.

   a. ____

   b. ____

   c. ____

2. List five job opportunities open to skilled concrete masons.

   a. ____

   b. ____

   c. ____

   d. ____

   e. ____

3. List five major subskills involved in the concrete masonry trade.

   a. ____

   b. ____

   c. ____

   d. ____

   e. ____

4. Select from the following list personal attributes or attitudes that an employer looks for in an employee. Write an "X" in the blank before each correct answer.

   ______a. Personal grooming

   ______b. Knowledge of machinery

   ______c. Desire to work

   ______d. Alertness, quickness of mind

TEST

______e. Desire to improve one's financial status

______f. Enthusiasm and interest

______g. Knowledge and pride in the trade

______h. Dedication and dependability

______i. Desire to help others

______j. Honesty and integrity

5. List documents that an applicant may need to prepare when applying for a job.

   a. ____

   b. ____

   c. ____

   d. ____

(NOTE: Test items 6 through 11 list the assignment sheets that are considered an important part of this test. If they have not been completed, check with your instructor.)

6. Write a résumé.
7. Write a letter of application.
8. Complete an employment application.
9. Make an interview appointment by telephone for a concrete masonry job.
10. Write a follow-up letter or make a follow-up telephone call after interviewing for a concrete masonry job.
11. Complete a W-4 form.

INDUSTRY ORIENTATION
UNIT III

ANSWERS TO TEST

1. Answer should include any three of the following.

   a. Preparation
   b. Apprenticeship
   c. Post-secondary
   d. Upgrade

2. Answer should include any five of the following.

   a. Construction
   b. Construction management
   c. Training
   d. Concrete industry
   e. Remodeling, restoration, and maintenance
   f. Materials and tool sales and service

3. Answer should include any five of the following.

   a. Blueprint reading
   b. Measuring and layout
   c. Estimating
   d. Tools' use
   e. Form building
   f. Placing, compacting, and rodding concrete
   g. Finishing concrete
   h. Rubbing and patching concrete
   i. Curing concrete
   j. Understanding material characteristics
   k. Field testing

4. c, d, f, g, h, i, j

5. a. Résumé
   b. Letter of application
   c. Job application
   d. Follow-up letter

ANSWERS TO TEST

6. Completed to the satisfaction of the instructor

7. Completed to the satisfaction of the instructor

8. Completed to the satisfaction of the instructor

9. Completed to the satisfaction of the instructor

10. Completed to the satisfaction of the instructor

11. Completed to the satisfaction of the instructor

HISTORY OF THE CEMENT INDUSTRY
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to state the differences between cement and concrete and state facts relating to the history of the cement industry. The student should also be able to label the steps in modern cement production. The student will show this ability by completing the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with cement.
2. State the definitions of *cement* and *concrete*.
3. State facts relating to the history of the cement industry.
4. Label an illustration showing the steps in modern cement production.
5. Match common types of portland cement to their correct uses.

HISTORY OF THE CEMENT INDUSTRY
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

    1. Supplement #1 — Joseph Aspdin's Patent

    2. Transparency masters

      a. TM #1 — Raw Materials Used in Making Portland Cement

      b. TM #2 — Eddystone Lighthouse

      c. TM #3 — Allen House: One of the Oldest Concrete Structures in the United States

      d. TM #4 — Coplay, Pennsylvania: Site of the First Portland Cement Plant in the United States

      e. TM #5 — Modern Cement Production

      f. TM #6 — Bag of Portland Cement

  C. Information sheet

  D. Test

  E. Answers to test

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Obtain materials to supplement unit.

    1. Samples of cement and raw materials used in cement

    2. Transparencies and competency profiles

(NOTE: Transparencies and competency profiles for this book are available from the Curriculum and Instructional Materials Center, State Department of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street N.W., Washington, D.C. 20006; phone 202-393-2040.)

SUGGESTED ACTIVITIES

3. Books

   a. *Occupational Outlook Handbook, Bulletin 1700*

   (NOTE: This bulletin may be ordered from U.S. Department of Labor, Bureau of Labor Statistics, U.S. Government Printing Office, Washington, D.C.)

   b. *The Making of Portland Cement*

   c. *Cement Mason's Manual for Residential Construction*

   (NOTE: Order *b* and *c* from Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077.)

   d. *Concrete Technology* by George R. White

   (NOTE: This book may be ordered from Delmar Publishers, Inc.; 2 Computer Drive, West; Box 15-015; Albany, New York 12212.)

4. Audiovisual presentations

   (NOTE: The following presentations can be ordered from the Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077.)

   a. *Magic Powder Called Portland Cement*

   (NOTE: This film covers what portland cement is, how it works, and how it is made. Described are the cement hydration process and the production of portland cement from raw materials to finished product. Also covered are the wet, semi-dry, and dry processes of manufacturing, emphasizing the new technology—preheaters, precalciners, roller mills, and polution-control devices. The film includes segments on the work of the Portland Cement Association and the cement industry's efforts to preserve and reclaim the environment.)

   b. *Twelve Decades of Concrete in American Architecture*

   (NOTE: These films cover the history of concrete as it has been used in architecture from 1844 through the 1960s.)

   Part 1 — "The Long Years of Experiment (1844-1920)";
   16 Minutes, 1965. Order number PC091.

   Part II — "The Search for a New Architecture (1920-1950)";
   12 Minutes, 1965. Order number PC092.

   Part III — "The Material That Can Do Almost Anything (1950-1964)"; 21 Minutes, 1965. Order number PC093.

SUGGESTED ACTIVITIES

Part IV — "The Architect's Material (1960's)"; 23 Minutes, 1965. Order number PC094.

Part V — "New Dimensions in Concrete (Through the 60's)"; 16 Minutes, 1970. Order number PC168.

c. *History of the Cement Business*, 35 slides, 1981. Order number SS176.

(NOTE: These slides review development of cement manufacturing process from Roman to modern times. Included are the uses of natural cement, the invention of portland cement in England, and the birth of the American cement industry.)

C. Provide students with unit.

D. Introduce unit.

SUGGESTIONS:

- Discuss the history of the cement industry and what an important discovery cement was. Make books and audiovisuals on the subject readily available to students.
- Discuss unit and specific objectives.

E. Discuss information sheet.

1. Use Information Sheet, Section I, to introduce students to terms associated with cement.

SUGGESTIONS:

- Show students examples of terms when appropriate.
- Explain how knowing these terms and definitions will help students to better understand the unit.

2. Use Information Sheet, Section II, to discuss and to distinguish between *cement* and *concrete*.

SUGGESTIONS:

- Explain that cement is an ingredient in concrete; also explain that the finished product should be called *concrete*—not cement. Most people use the terms interchangeably and this is incorrect.

  EXAMPLE: A finished sidewalk is not a *cement* sidewalk; it is a *concrete* sidewalk.

- Use Transparency #1, "Raw Materials Used in Making Portland Cement," to illustrate your discussion.

SUGGESTED ACTIVITIES

3. Use Information Sheet, Section III, to discuss facts relating to the history of the cement industry.

   SUGGESTIONS:

   - Explain that knowing these historical facts will not make the students better concrete masons, but this knowledge may help students better understand the importance of cement and concrete.
   - For Supplement #1, "Joseph Aspdin's Patent," make a transparency as well as copies to hand out to students. Also, show Transparencies #2 through #4 to illustrate your discussion.
   - Point out that in the United States, as of 1986, there are forty-seven cement companies that operate 136 plants with a total yearly capacity of approximately eighty-five million tons of portland cement.

4. Use Information Sheet, Section IV, to discuss steps in modern cement production.

   SUGGESTIONS:

   - Show Transparency #5 to illustrate your discussion of the manufacturing process.
   - Discuss the progress that has been made in the cement industry over the years. Reread Supplement #1 and compare Joseph Aspdin's process with modern cement production.
   - If possible, take a field trip to a cement plant and point out all the procedures in the production of cement, from the raw material in the quarry to the finished product in the shipping department.
   - Show students samples of the raw materials used in cement, and discuss these materials.
   - Discuss the #200 sieve, which finished cement must pass through. Explain how fine the 40,000 openings per square inch are. Have the students draw a picture 1-inch square and then try to show 40,000 openings in it. Point out that this sieve is so fine that it will hold water and that the cement that comes through this sieve is even finer than face powder.

5. Use Information Sheet, Section V, to discuss common types of portland cement and their uses.

   SUGGESTIONS:

   - Explain to students that many people believe that portland cement is a brand name, but it is not; it is a type of cement.

SUGGESTED ACTIVITIES

- Discuss the various types of portland cements and other types of cements used for special purposes.
- Show the film *Magic Powder Called Portland Cement*.
- Explain how cement is packaged and transported. Cement is packaged in barrels and transported in trucks; but students will probably see it only in bags, which weigh 94 pounds each and equal one cubic foot in volume. Show Transparency #6.

F. Give test.

G. Critique test and discuss in class.

H. Reteach and retest as necessary.

I. Complete appropriate section of competency profiles.

III. Unit references

A. Hendrix, Laborn J. "Bud". *Cement Mason's Curriculum*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1975.

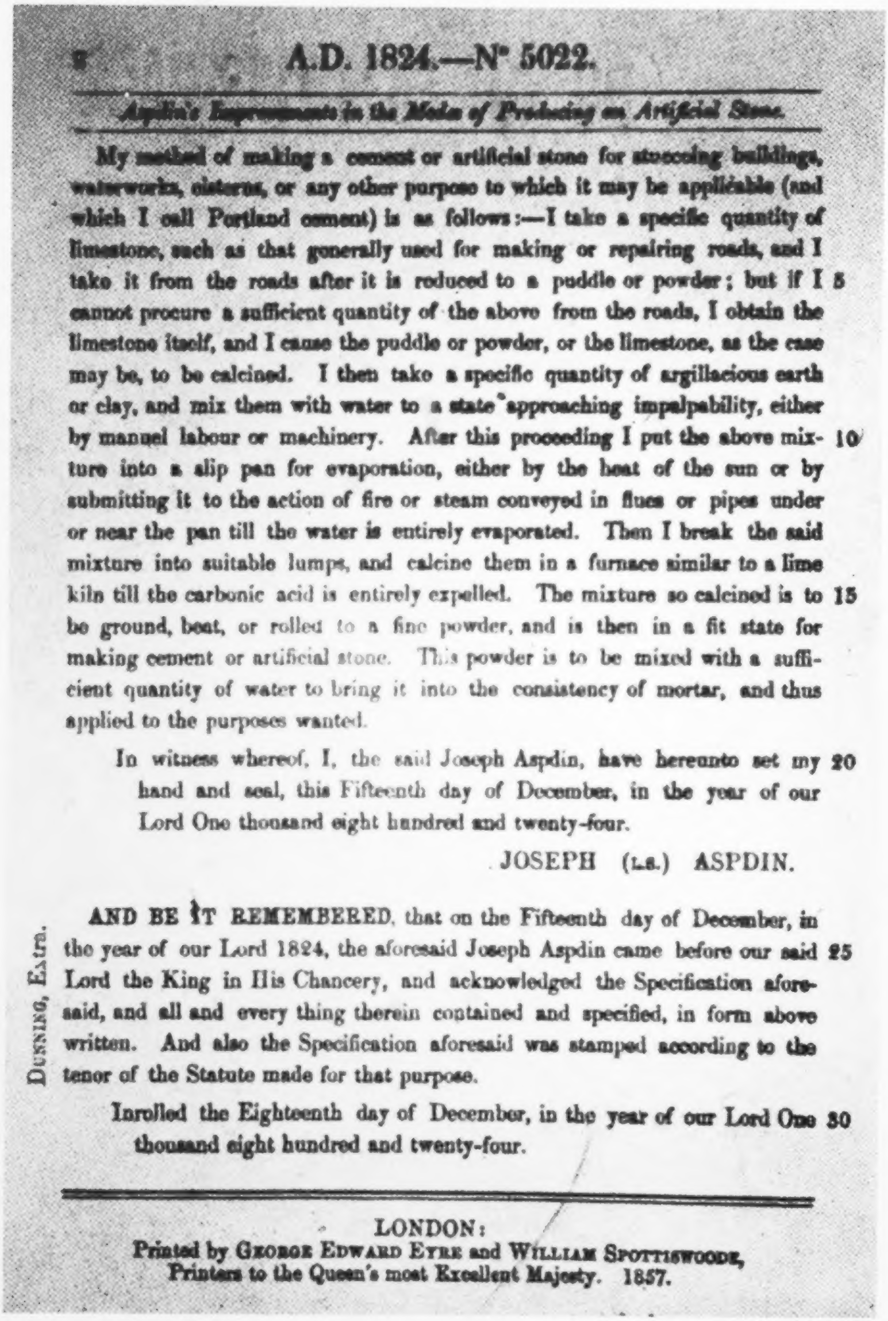
B. *The Making of Portland Cement*. Skokie, Illinois: Portland Cement Association, 1964.

C. *Quality Concrete Slide Reference File*. Skokie, Illinois: Portland Cement Association, n.d.

D. White, George, R. *Concrete Technology*. Albany, New York: Delmar Publishers Inc., 1977.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — JOSEPH ASPDIN'S PATENT



A.D. 1824.—N° 5022.

Aspdin's Improvements in the Mode of Producing an Artificial Stone.

My method of making a cement or artificial stone for stuccoing buildings, waterworks, cisterns, or any other purpose to which it may be applicable (and which I call Portland cement) is as follows:—I take a specific quantity of limestone, such as that generally used for making or repairing roads, and I take it from the roads after it is reduced to a puddle or powder; but if I cannot procure a sufficient quantity of the above from the roads, I obtain the limestone itself, and I cause the puddle or powder, or the limestone, as the case may be, to be calcined. I then take a specific quantity of argillacious earth or clay, and mix them with water to a state approaching impalpability, either by manuel labour or machinery. After this proceeding I put the above mixture into a slip pan for evaporation, either by the heat of the sun or by submitting it to the action of fire or steam conveyed in flues or pipes under or near the pan till the water is entirely evaporated. Then I break the said mixture into suitable lumps, and calcine them in a furnace similar to a lime kiln till the carbonic acid is entirely expelled. The mixture so calcined is to be ground, beat, or rolled to a fine powder, and is then in a fit state for making cement or artificial stone. This powder is to be mixed with a sufficient quantity of water to bring it into the consistency of mortar, and thus applied to the purposes wanted.

In witness whereof, I, the said Joseph Aspdin, have hereunto set my hand and seal, this Fifteenth day of December, in the year of our Lord One thousand eight hundred and twenty-four.

JOSEPH (L.S.) ASPDIN.

DUNNING, Extr.

AND BE IT REMEMBERED, that on the Fifteenth day of December, in the year of our Lord 1824, the aforesaid Joseph Aspdin came before our said Lord the King in His Chancery, and acknowledged the Specification aforesaid, and all and every thing therein contained and specified, in form above written. And also the Specification aforesaid was stamped according to the tenor of the Statute made for that purpose.

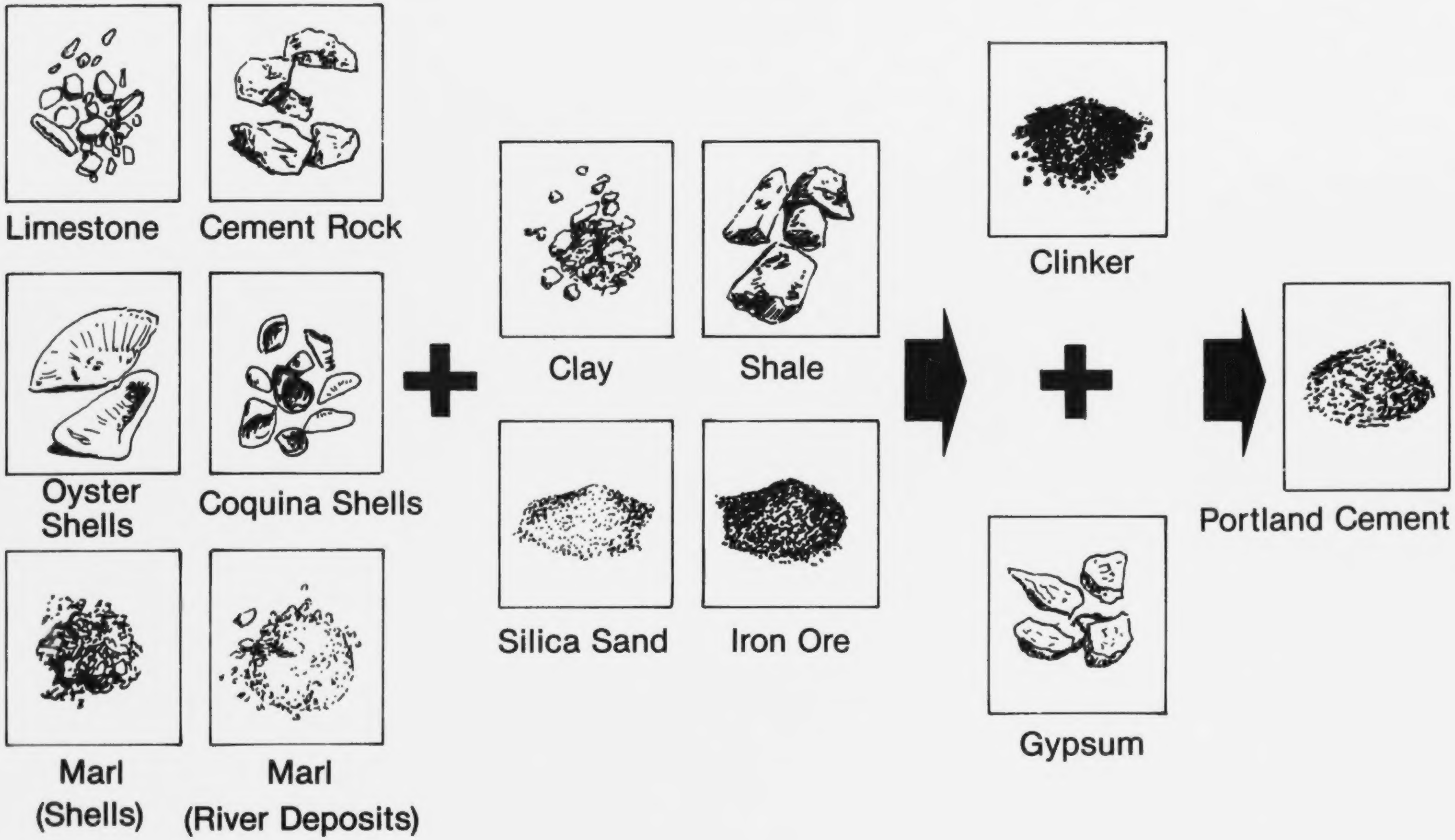
Inrolled the Eighteenth day of December, in the year of our Lord One thousand eight hundred and twenty-four.

LONDON:
Printed by GEORGE EDWARD EYRE and WILLIAM SPOTTISWOODE,
Printers to the Queen's most Excellent Majesty. 1857.

Courtesy Portland Cement Association.

BEST COPY AVAILABLE

Raw Materials Used in Making Portland Cement



Limestone

Cement Rock

Oyster Shells

Coquina Shells

Marl (Shells)

Marl (River Deposits)

Clay

Shale

Silica Sand

Iron Ore

Clinker

Gypsum

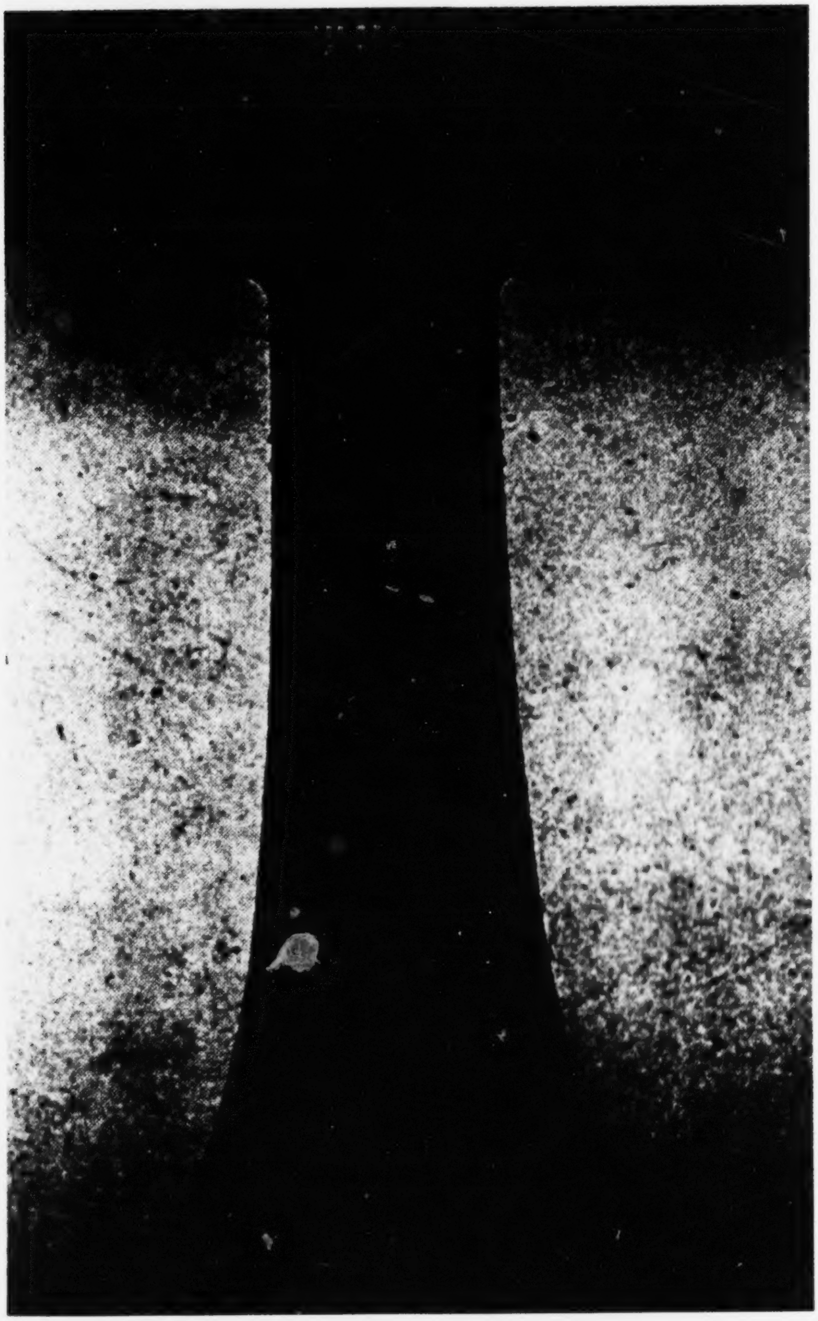
Portland Cement

TM #1

FCCM - 131-A

FCCM - 133-A

Eddystone Lighthouse



Courtesy Portland Cement Association.

TM #2

Allen House: One of the C
Structures in the Uni

Courtesy Portland Cement Associa

TM #3

# of the Oldest Concrete
the United States

and Cement Association.

120

FCCM - 135-A

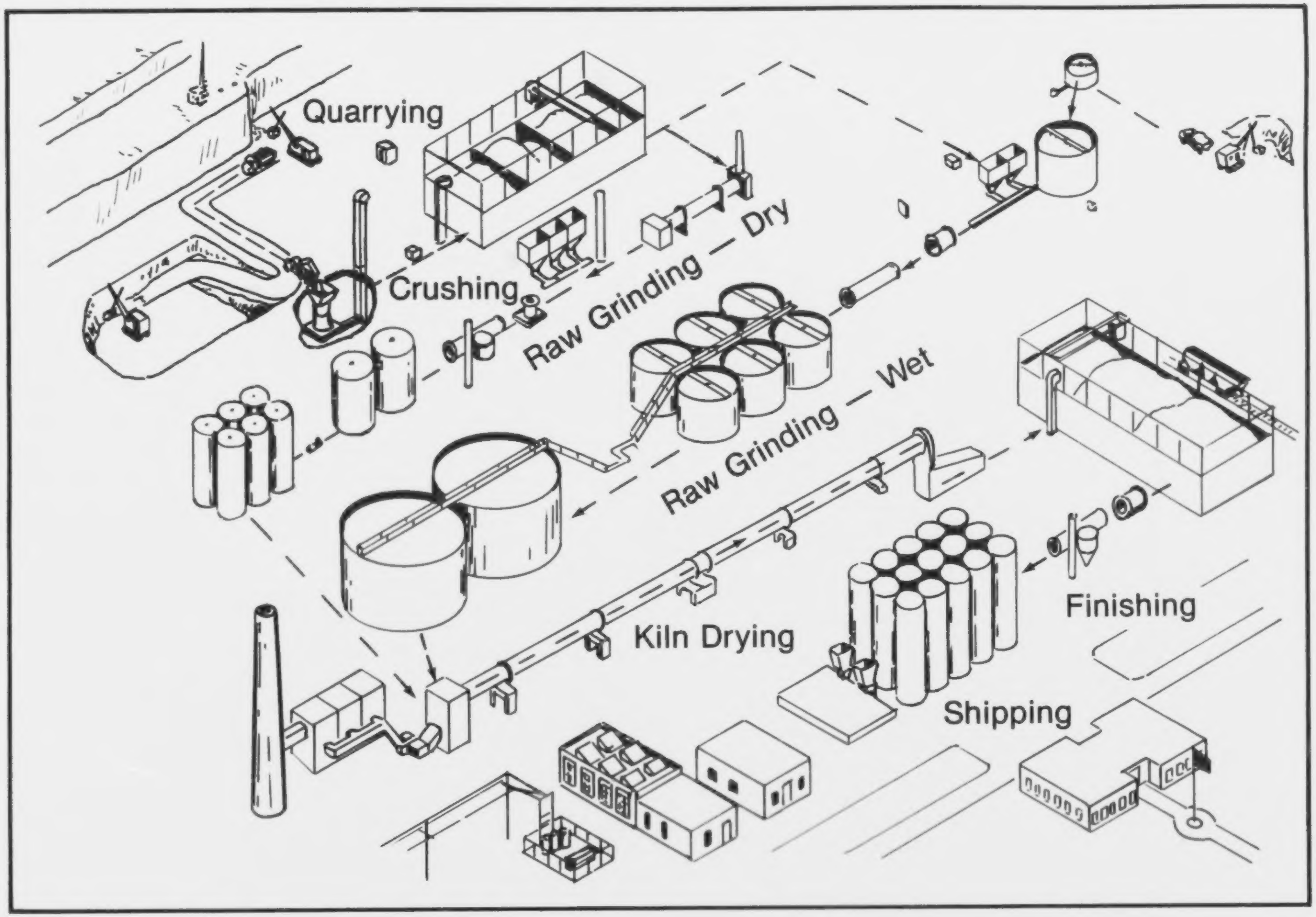
Coplay, Pennsylvania: S
Portland Cement Plant in th

Courtesy Portland Cement Associatio

vania: Site of First nt in the United States

d Cement Association.

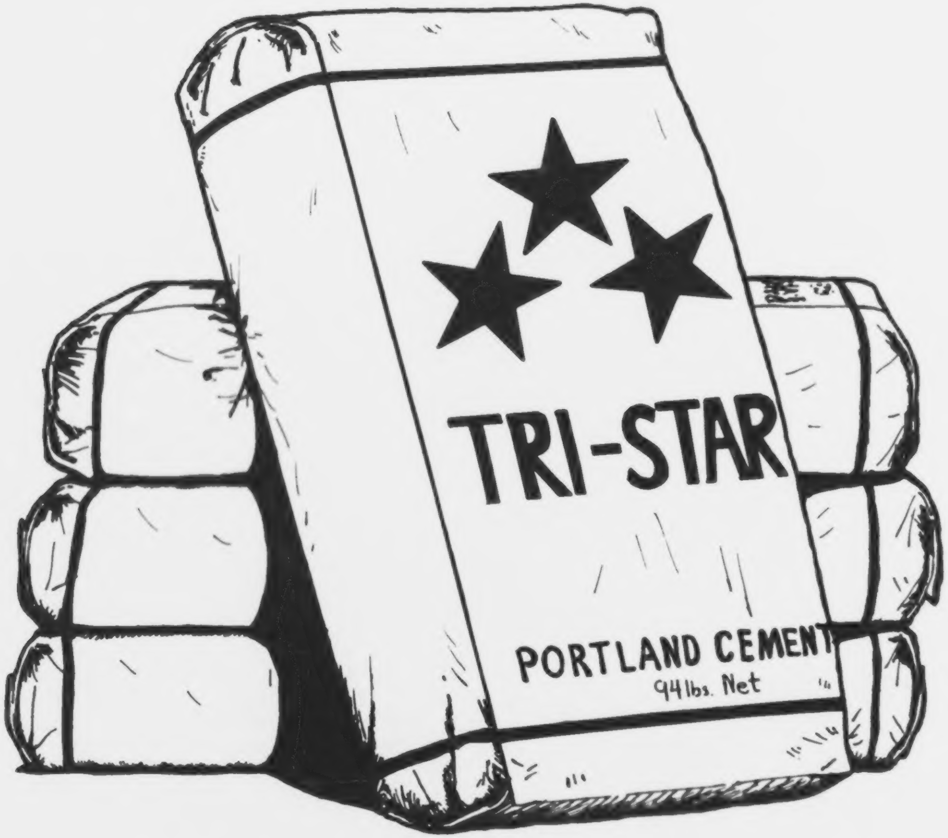
Modern Cement Production


Quarrying
Crushing
Raw Grinding — Dry
Raw Grinding — Wet
Kiln Drying
Finishing
Shipping

TM #5

FCCM - 139-A

Bag of Portland Cement


TRI-STAR
PORTLAND CEMENT
94lbs. Net

TM #6

FCCM - 141-A

HISTORY OF THE CEMENT INDUSTRY
UNIT IV

INFORMATION SHEET

I. Terms and definitions associated with cement

A. Hydraulic cement — Cement capable of setting and hardening under water due to interaction of water and the constituents of cement

B. Portland cement — Type of finely ground cement

(NOTE: *Portland* is not a brand name; it is a type of cement that was so named because the concrete made with it resembled a fine building stone quarried on the Isle of Portland, England.)

C. Portland Cement Association (PCA) — Organization with the goals of improving and extending the uses of portland cement and concrete

D. Kiln — Oven, furnace, or heated enclosure used to process cement by burning, firing, or drying

II. Definitions of *cement* and *concrete*

A. Cement — Powder made from alumina, silica, lime, iron oxide, and magnesia burned together in a kiln and finely pulverized; an ingredient in concrete

(NOTE: During the cement manufacturing process, two types of raw materials [one made primarily from limestone, marl, and shells and another made primarily from clay, shale, silica sand, iron ore, and alumina] are blended, ground, and dried; then clinker and gypsum are added and that mixture is ground again. After the manufacturing process is complete, cement is ground so finely that it will pass through a #200 seive, which has 40,000 openings per square inch.)

B. Concrete — Building material made by mixing cement, sand, and gravel with water

III. Facts relating to the history of the cement industry

(NOTE: Natural cements have been in use for a long, long time. By 200 B.C., the burning of lime in pot kilns had become an art, and a pozzolanic lime had been used by the Phoenicians in 700 B.C. In 70 B.C., Roman historians described the use of Roman cement, or hard-burned lime. And hydraulic cement was produced in Holland in 1200 A.D. However, the durability of various natural cements varied and people began looking for a consistently durable cement composition, which resulted in the eventual development of portland cement in 18th century England.)

INFORMATION SHEET

A. 1756 — English engineer John Smeaton successfully constructs Eddystone lighthouse using cement composition he developed (Figure 1)

(NOTE: The construction of the Eddystone lighthouse was the key step in the discovery of portland cement, giving Smeaton a good claim to being the inventor of portland cement, which he named. However, Smeaton did not publish facts about his discovery until 1791—about the same time another Englishman, Joseph Aspdin, discovered a similar cement.)

EXAMPLE: Eddystone lighthouse

FIGURE 1

Courtesy of Portland Cement Association.

B. 1824 — Portland cement is patented by Joseph Aspdin in London

(NOTE: Although Aspdin did not patent his process until 1824, he had actually been making cement since 1813, calling his product *portland cement* after the name given to it by Smeaton.)

C. 1844 — Isaac C. Johnson, another Englishman, develops a composition for synthetic portland cement proportioned much as we use today

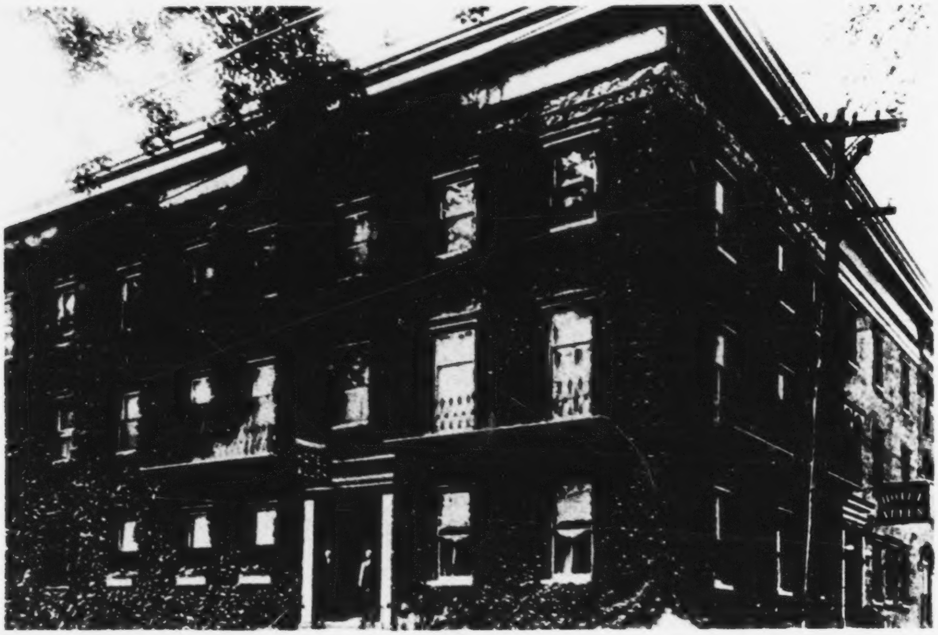
INFORMATION SHEET

D. 1868 — First shipment of portland cement arrives in the United States from Europe

(NOTE: Even though portland cement did not begin arriving in large amounts until 1868, the natural cement industry had been flourishing in the United States before that date. In 1769, a diversion dam made from natural hydraulic cement and built in San Diego, California, was probably the first concrete structure built in the United States. In 1818, natural cement was found in large quantities near Rosendale, New York, and large quantities of this cement were used in the construction of the Erie Canal. Other large cement districts were established in the Lehigh Valley in Pennsylvania and in Louisville, Kentucky, and smaller industries were developed in several other states. The Allen House, one of the oldest concrete structures still standing today, was built in Honesdale, Pennsylvania in 1857. See Figure 2. But it was not until 1868 that European portland cement manufacturers began to take notice of the increasing market for cement in this country and began shipping portland cement.)

EXAMPLE: Allen House

FIGURE 2



Courtesy of Portland Cement Association.

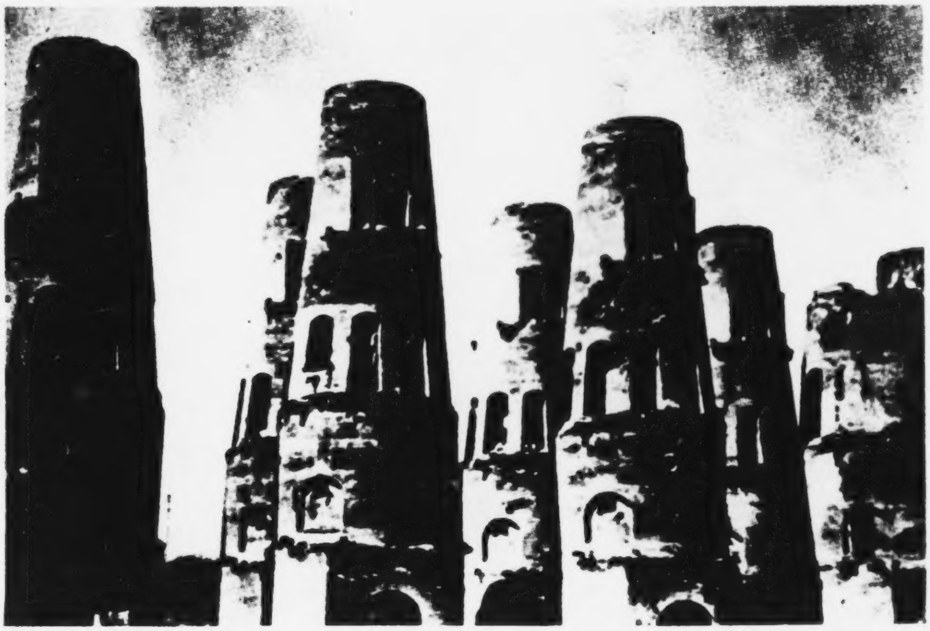
INFORMATION SHEET

E. 1871 — David O. Saylor formulates and patents a portland cement in Coplay, Pennsylvania, site of the first portland cement plant in the United States (Figure 3)

(NOTE: Saylor, a manufacturer of natural cement, became convinced that he could manufacture in the United States a product similar to the portland cement being shipped from Europe. He developed a process that produced a portland cement that could meet the same tests applied to imported cement, and he patented his process on September 26, 1871. This date is regarded as the beginning of the portland cement industry in the United States.)

EXAMPLE: First portland cement plant in the United States

FIGURE 3



Courtesy of Portland Cement Association.

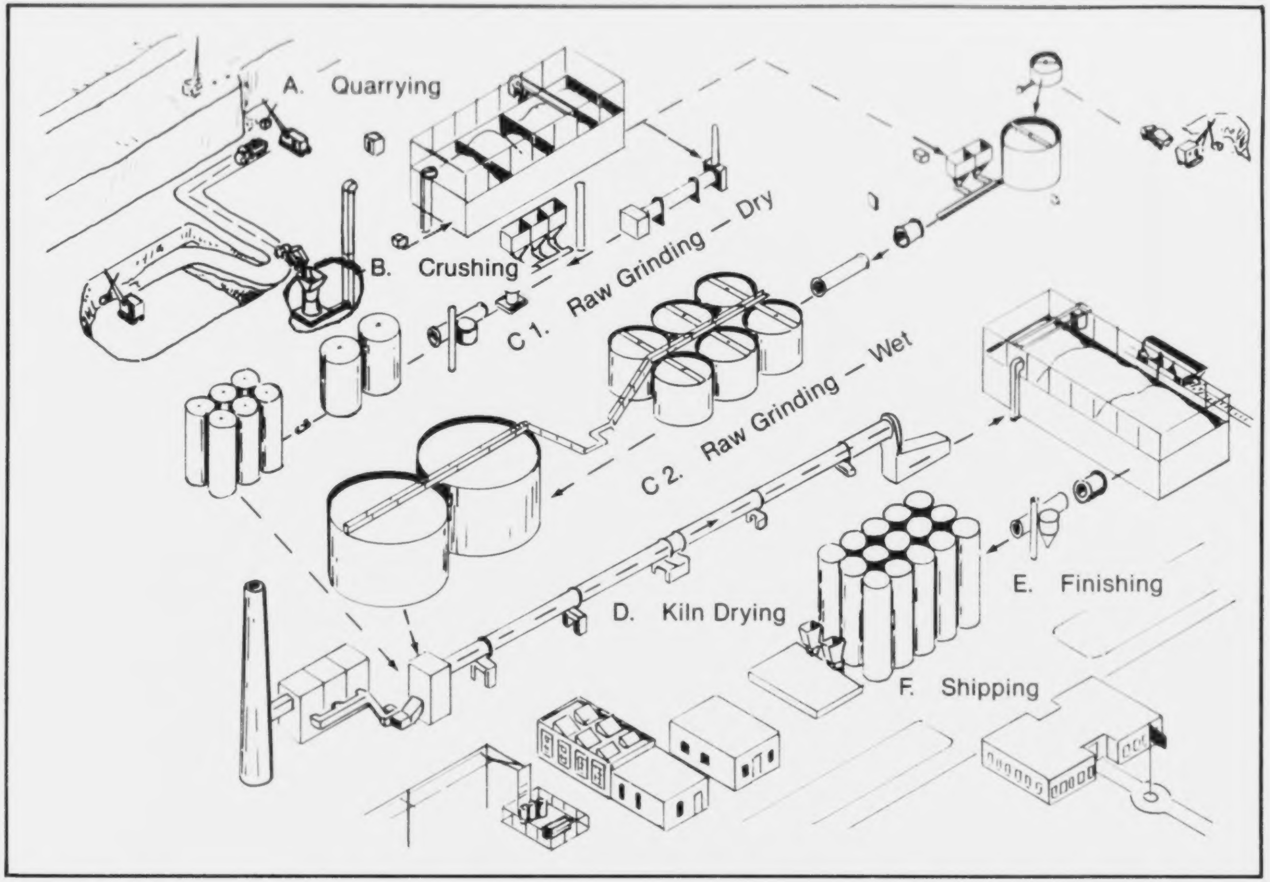
F. 1916 — Robert W. Lesley becomes first president of the PCA

(NOTE: Originally a very successful cement broker, selling both natural and portland cement, Lesley became an eminent manufacturer of portland cement, establishing a plant at Egypt, Pennsylvania. He also wrote a book, *History of the Portland Cement Industry in the United States*, which is considered one of the best books on the subject.)

INFORMATION SHEET

IV. Steps in modern cement production (Figure 4)

FIGURE 4


A. Quarrying
B. Crushing
C 1. Raw Grinding — Dry
C 2. Raw Grinding — Wet
D. Kiln Drying
E. Finishing
F. Shipping

INFORMATION SHEET

V. Common types of portland cement and their uses

(NOTE: Concrete strengths are determined by an engineer and are found in the specifications for different concrete projects.)

A. Type I — Normal portland cement used in general-purpose construction

B. Type II — Modified portland cement used in massive construction requiring moderate sulfate resistance, lower heat of hydration, and reduced alkali reactivity

C. Type III — Modified portland cement used in construction requiring high strength at an early age

D. Type IV — Modified portland cement used in massive construction requiring rate of heat to be kept at a minimum

E. Type V — Modified portland cement used in construction exposed to severe sulfate action

F. White portland cement — Pure white portland cement used for architectural effect

HISTORY OF THE CEMENT INDUSTRY
UNIT IV

TEST

NAME ______________________________ SCORE ____________

1. Match to their correct definitions terms associated with cement. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a. Type of finely ground cement

1. Hydraulic cement
2. Portland cement
3. Natural cement

_____b. Organization with the goals of improving and extending the uses of portland cement and concrete

1. PCA
2. ACI
3. OSHA

_____c. Cement capable of setting and hardening under water due to interaction of water and the constituents of cement

1. Hydraulic cement
2. Portland cement
3. White portland cement

_____d. Oven, furnace, or heated enclosure used to process cement by burning, firing, or drying

1. Sieve
2. Kiln
3. Quarry

2. State the definitions of *cement* and *concrete*.

a. Cement — ______________________________

b. Concrete — ______________________________

TEST

3. State four facts relating to the history of the cement industry.

   a. ______________________________

   ____

   ____

   b. ______________________________

   ____

   ____

   c. ______________________________

   ____

   ____

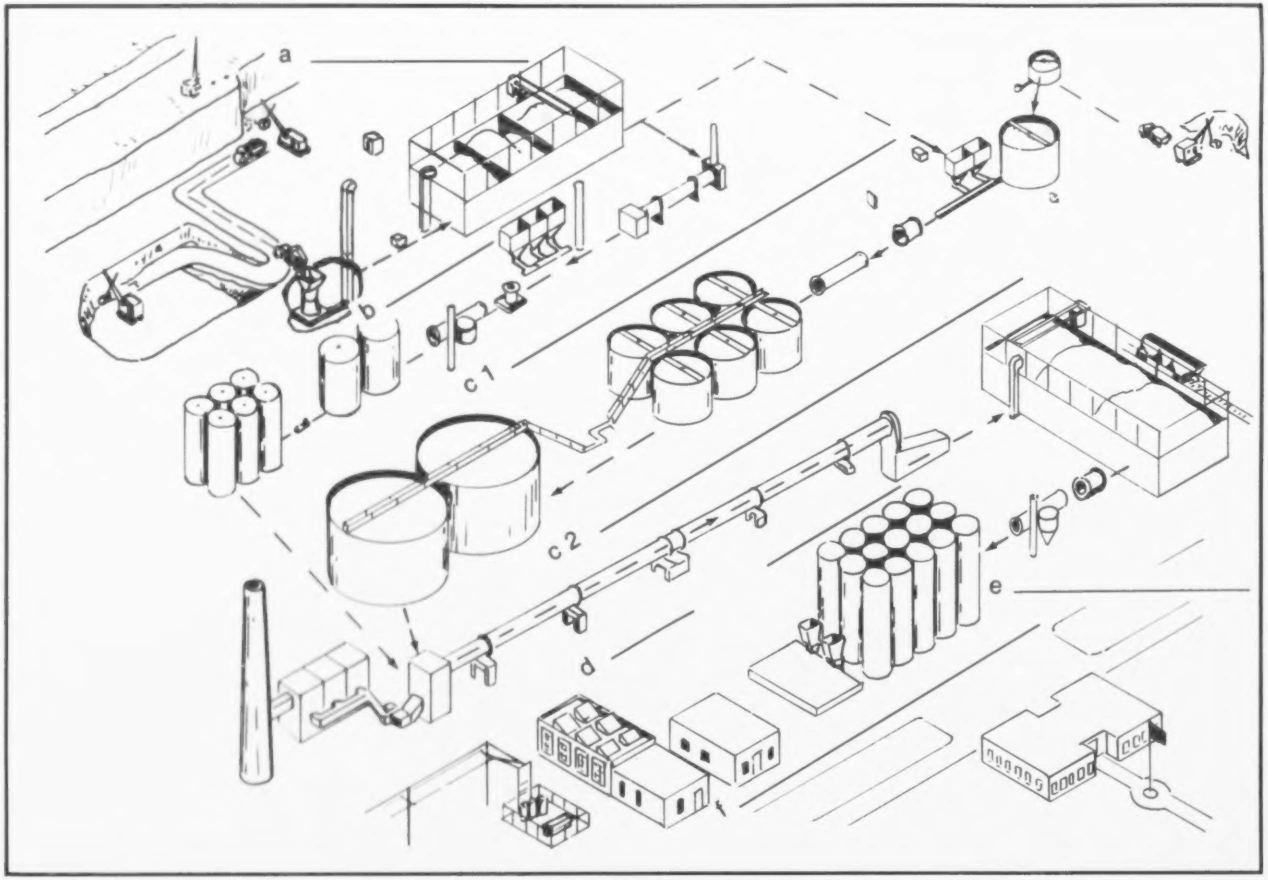
   d. ______________________________

   ____

   ____

TEST

4. Label the following illustration showing the steps in modern cement production.



TEST

5. Match common types of portland cement to their correct uses. Write the correct numbers in the blanks.

______a. Modified portland cement used in massive construction requiring rate of heat to be kept at a minimum

______b. Modified portland cement used in construction requiring high strength at an early age

______c. Modified portland cement used in construction exposed to severe sulfate action

______d. Normal portland cement used in general-purpose construction

______e. Modified portland cement used in massive construction requiring moderate sulfate resistance, lower heat of hydration, and reduced alkali reactivity

______f. Pure white portland cement used for architectural effect

1. Type I
2. Type II
3. Type III
4. Type IV
5. Type V
6. White portland cement

HISTORY OF THE CEMENT INDUSTRY
UNIT IV

ANSWERS TO TEST

1. a. 2
   b. 1
   c. 1
   d. 2

2. a. Cement — Powder made from alumina, silica, lime, iron oxide, and magnesia burned together in a kiln and finely pulverized; an ingredient in concrete
   b. Concrete — Building material made by mixing cement, sand, and gravel with water

3. Answer should include any four of the following.

   a. 1756 — English engineer John Smeaton successfully constructs Eddystone lighthouse using cement composition he developed
   b. 1824 — Portland cement is patented by Joseph Aspdin in London
   c. 1844 — Isaac C. Johnson, another Englishman, develops a composition for synthetic portland cement proportioned much as we use today
   d. 1868 — First shipment of portland cement arrives in the United States from Europe
   e. 1871 — David O. Saylor formulates and patents a portland cement in Coplay, Pennsylvania, site of the first portland cement plant in the United States
   f. 1916 — Robert W. Lesley becomes first president of the PCA

4. a. Quarrying
   b. Crushing
   c1. Raw grinding — dry
   c2. Raw grinding — wet
   d. Kiln drying
   e. Finishing
   f. Shipping

5. a. 4 d. 1
   b. 3 e. 2
   c. 5 f. 6

SAFETY AND BASIC FIRST AID

UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to practice safety on the job and perform basic first aid. The student will show this ability by completing job sheets and unit test with a minimum score of 100 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with safety.
2. State reasons why you must be safety conscious on the job.
3. State consequences of a worker's using alcohol or drugs on the job.
4. State job-safety rules.
5. State safety precautions pertaining to scaffolds.
6. State safety precautions pertaining to ladders.
7. Match colors of the safety color code to their correct applications.
8. Match classes of fires to their correct descriptions.
9. Match terms and definitions associated with toxic substances.
10. List toxic substances a concrete mason may contact on the job.
11. List forms of toxic substances.
12. State ways toxic substances enter the body.
13. Define ways toxic substances affect the body.
14. Discuss consequences of exposure to toxic substances.
15. Select correct definitions of terms associated with first aid.
16. State reasons why knowledge of first aid is important.
17. List concrete masonry job-related injuries that may require first aid.
18. Arrange in order first-aid actions to follow in an emergency.

OBJECTIVE SHEET

19. Describe the symptoms of traumatic shock.
20. State measures to take for prevention of heat stroke, heat cramps, and heat exhaustion.
21. Distinguish between symptoms of heat stroke and heat exhaustion.
22. State measures to take for prevention of frostbite.
23. Describe symptoms of frostbite.
24. Identify pressure points to use to control bleeding from various areas of the body.
25. Classify burns by degree according to their symptoms.
26. State guidelines for administering first aid to a victim with an eye injury.
27. Discuss signs and symptoms of fractures.
28. State guidelines for administering first aid to a victim with a suspected fracture.
29. Demonstrate the ability to
    a. Properly lift a heavy object.
    b. Perform first-aid treatment for simulated accident victims.

SAFETY AND BASIC FIRST AID
UNIT V

SUGGESTED ACTIVITIES

I. Unit contents

- A. Objective sheet
- B. Suggested activities
  - 1. Supplements
    - a. Supplement #1 — Safety and First-Aid Crossword Puzzle
    - b. Supplement #2 — Properly Dressed Concrete Mason
    - c. Supplement #3 — Types of Safety Equipment Used by Concrete Masons
    - d. Supplement #4 — How to Lift Safely
    - e. Supplement #5 — Sample Safety Forms
    - f. Supplement #6 — General Directions for Giving First Aid
    - g. Supplement #7 — How to Beat the Heat
  - 2. Transparency masters
    - a. TM #1 — Correct Way to Lift Heavy Objects
    - b. TM #2 — Ladder Safety
    - c. TM #3 — Ladder Danger
    - d. TM #4 — Types of Fire Extinguishers
    - e. TM #5 — Standard Letter Symbols for Fire Extinguishers
    - f. TM #6 — New Pictorial Symbols Used to Label Fire Extinguishers
    - g. TM #7 — Fire Extinguisher Suitable for Class B and Class C Fires
    - h. TM #8 — Fire Triangle
    - i. TM #9 — Fire Tetrahedron
    - j. TM #10 — Face and Skin Conditions in Heat Stroke and Heat Exhaustion
- C. Information sheet

SUGGESTED ACTIVITIES

D. Assignment sheets
   1. Assignment Sheet #1 — Identify Proper Dress for a Concrete Mason
   2. Assignment Sheet #2 — Visit a Job Site and Complete a Safety Checklist
   3. Assignment Sheet #3 — Match Fire-Extinguisher Symbols to Given Types of Fires
   4. Assignment Sheet #4 — Identify Job-Site and Shop Safety Violations
   5. Assignment Sheet #5 — Analyze Case Studies to Determine Correct First-Aid Treatments

E. Answers to assignment sheets

F. Job sheets
   1. Job Sheet #1 — Properly Lift a Heavy Object
   2. Job Sheet #2 — Perform First-Aid Treatment for Simulated Accident Victims

G. Test

H. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

(NOTE: It is highly recommended that a certified first-aid instructor teach this unit.)

B. Order or obtain materials to supplement unit.
   1. Films and slide sets
      a. *Housekeeping Means Safe Keeping*. Color, 10 minutes, Journal Films, Inc., 1975. Available from Journal Films, Inc., 930 Pitner Avenue, Evanston, Illinois 60202.

         (NOTE: This film begins by taking the audience to a typical plant where a variety of housekeeping violations are presented. The dangers of these violations are then forcefully dramatized in the slow-motion recreation of a painful and realistic accident.)

      b. *Stop a Fire Before It Starts*. Color, 10 minutes, Journal Films, Inc., 1975. Available from Journal Films, Inc., 930 Pitner Avenue, Evanston, Illinois 60202.

         (NOTE: In easy-to-understand laboratory demonstrations, this film shows how everyday materials become explosive in the presence of sparks, cigarettes, and so on. From the laboratory, the film moves to typical on-the-job locations where hazardous fire situations are encountered and their blazing conclusions displayed. Most importantly, viewers learn why these situations were hazardous and what could have been done to prevent these fires.)

SUGGESTED ACTIVITIES

c. *A New Way to Lift*. Color, 9 minutes, Journal Films, Inc., 1970. Available from Journal Films, Inc., 930 Pitner Avenue, Evanston, Illinois 60202.

(NOTE: This film, produced in conjunction with the National Safety Council, demonstrates body mechanics that apply to all lifting situations. By following these tips, students may avoid serious back injury.)

d. *The Industrial Weightlifter II*. Color, 11 minutes, Ruddel Films for Industrial Accident Prevention Association, Ontario and Canada Packers, Ltd., 1981. Available from International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Illinois 60604.

(NOTE: Visuals have been updated in this new version that illustrates correct techniques for lifting heavy objects to prevent injury.)

(NOTE: Films "e" through "i" in the following list are available to Oklahoma teachers on a free-loan basis. Oklahoma teachers may order these films from the Curriculum and Instructional Materials Center, Oklahoma State Department of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074. Out-of-state teachers must order from the addresses listed with the films.)

e. *An Option to See*. Color, 18 minutes, Society to Prevent Blindness, 1977. Available from the Society to Prevent Blindness in your state.

(NOTE: This safety film stresses the importance of wearing safety glasses while working around machinery.)

f. *Don't Push Your Luck*. Color, 12 minutes, Harvest Films, Inc., 1978. Available from Harvest Films, Inc., 309 Fifth Avenue, New York, New York 10016.

(NOTE: In this film Bill Frank, an actual victim, recreates his real-life blinding accident. He delivers powerful safety messages to industrial employees and shows proper eye and face protection.)

g. *It's Up to You*. Color, 11 minutes, Harvest Films, Inc., 1960. Available from Harvest Films, Inc., 309 Fifth Avenue, New York, New York 10016.

(NOTE: This is an award-winning film on eye safety.)

h. *Eye Injuries*. Color, 6 minutes, International Film Bureau, 1981. Available from International Film Bureau, Inc., 332 South Michigan Avenue, Chicago, Illinois 60604.

(NOTE: This film demonstrates the procedure for removing particles from under the eyelid.)

SUGGESTED ACTIVITIES

i. *On Every Hand*. Color, 10 minutes, Journal Films, Inc., 1970. Available from Journal Films, Inc., 930 Pitner Avenue, Evanston, Illinois 60202.

   (NOTE: This film demonstrates how to avoid serious hand injuries that could be caused by commonly used and dangerous equipment.)

j. *How to Avoid 16 Leading Causes of OSHA Citations*. 20 minutes, Bureau of Business Practice, n.d. Available from Bureau of Business Practice, 24 Rope Ferry Road, Waterford, Connecticut 06386.

   (NOTE: This film shows the most common OSHA violations and tells how to avoid them.)

k. *Safety in the Shop: Basic Practices*. Black and white, 13 minutes, Coronet Films, 1970. Available from Coronet Films, 65 East South Water Street, Chicago, Illinois 60601.

   (NOTE: This film emphasizes the worker's responsibility for safety in using hand and power tools. It explains the importance of a clean shop, proper clothing, correct ways to lift, and ways to guard against fires.)

l. *Danger Zone: Your Back*. Color, 18 minutes, Visucom Productions, 1981. Available from Visucom Productions, P.O. Box 5472, Redwood City, California 94063.

   (NOTE: This safety film demonstrates good lifting, pulling, and pushing practices and is designed to motivate employees to participate in accident prevention.)

(NOTE: Films "m" through "s" and slide set "t" are available from Portland Cement Association, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077-9973.)

m. *Be a Pro*. 14 minutes, n.d., catalog number PC146, rental only.

   (NOTE: This film shows action shots of various sports that illustrate why professional players use the best equipment to protect themselves from injury.)

n. *Bend Your Knees*. 22 minutes, 1977, catalog number PC214, rental only.

   (NOTE: This film shows proper lifting techniques to avoid back injuries.)

SUGGESTED ACTIVITIES

o. *Hazard*. 32 minutes, n.d., catalog number PC140, rental only.

(NOTE: This film illustrates the importance of good work habits and carrying out instructions.)

p. *Inner Mind of Milton Whitty*. 19 minutes, n.d., catalog number PC203, rental only.

(NOTE: In this film Whitty makes provocative statements about safety that apply to employers, supervisors, and workers.)

q. *Multiple Choice*. 24 minutes, 1976, catalog number PC205, rental only.

(NOTE: The situations presented in this film involve road-construction and quarry-haulage mobile equipment that result in accidents.)

r. *Rigging Wire-Rope Slings*. 18 minutes, 1976, catalog number PC217, rental only.

(NOTE: This film explains conditions required for safe and proper rigging procedures.)

s. *Total Loss Control*. 10 minutes, 1972, catalog number PC210, rental only.

(NOTE: The message presented in this film points out that industry must direct its accident-protection efforts toward incidents that can result in injury, damage, or loss.)

t. *Occupational Respiratory Protection for Workers*. 51 slides, 11 minutes, 1979, catalog number CSO 17.092; includes carousel tray and tape cassette.

(NOTE: The slide set explains hazards, protective equipment, and preventive measures.)

u. *There's Something in the Air*. 30 slides with cassette, National Safety Council, n.d. Available from National Safety Council, P.O. Box 11933, Chicago, Illinois 60611, (312) 527-4800.

(NOTE: This program tells workers how to protect themselves from contaminated air—fogs, mists, fumes, gases, smokes, sprays, and vapors—that could be harmful to their lungs.)

2. Videotape and booklet concerning drugs and the workplace

(NOTE: A video and a booklet are available from The Associated General Contractors of America [AGC], Publications Department, 1957 E Street N.W., Washington, D.C. 20006.)

a. *Drug-Free Workplace*, videotape, AGC, 1986, order number 161.

b. *Guide to Drug-Free Jobsites*, AGC, 1986, order number 160.

SUGGESTED ACTIVITIES

3. Safety signs, posters, and other films or filmstrips

   (NOTE: Various safety educational material and filmstrips are available from Underwriters Laboratories, Inc., Public Information and Education Services, 207 East Ohio Street, Chicago, Illinois 60611.)

4. Audiovisual catalog

   (NOTE: A catalog on training programs on diverse safety and health topics is available from National Audio Visual Center, National Archives and Records Administration, Customer Services Section CL, 8700 Edgeworth Drive, Capitol Heights, Maryland 20743-3701.)

5. Full-color transparencies from the unit "Fire Behavior" in the International Fire Services Training Association manual *Essentials of Fire Fighting*.

   (NOTE: This box of seventeen transparencies covering the burning process includes a plastic universal mount and an interleaf of each transparency for use by the instructor in a teaching outline. This set of transparencies is available from Fire Protection Publications, Oklahoma State University, Stillwater, Oklahoma 74078, or call toll-free [800] 654-4055.)

6. Transparencies, competency profiles, and shop signs

   (NOTE: Transparencies, competency profiles, and shop safety signs for this book are available from The Associated General Contractors of America, 1957 E Street N.W., Washington, D.C. 20006, or from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.)

C. Introduce unit.

SUGGESTIONS:

- Stress the importance of safety and first aid, particularly as related to the concrete masonry trade. Also explain to students that studies show there is a much greater risk for injury when students become comfortable in performing skills because they tend to become more careless.
- Explain how safe practices and habits may prevent injuries, loss of equipment, loss of materials, and may even save lives.
- Discuss the Good Samaritan Act by asking the following questions. Is the act practiced actively in your community? How actively is it practiced? What persons does the act specifically cover?
- Use instances that you know of or have heard about, or use case studies to point out the importance of knowing how to administer first aid.

SUGGESTED ACTIVITIES

D. Provide students with objective sheet. Discuss unit and specific objectives, pointing out that the safety and first-aid materials in this unit are important enough to require a score of 100 percent on the unit test.

E. Provide students with information, assignment, and job sheets.

F. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I, to introduce students to terms and definitions associated with safety.

   SUGGESTIONS:

   - Explain how knowing the terms and definitions will help the student understand and grasp the importance of this unit.
   - Have students review terms associated with safety and first aid by beginning Supplement #1, "Safety and First-Aid Crossword Puzzle," or you may want to delay using this supplement until all the terms-and-definition sections in this unit have been reviewed.

2. Use Information Sheet, Section II, to discuss reasons why you must be safety conscious on the job.

   SUGGESTIONS:

   - Discuss how important it is to you and to your family, friends, co-workers, and employer that you be safety conscious on the job.
   - Have each student make a list of all the people who could be affected if an injury occurred to him or her while on the job. Then discuss how an injury to the head of a household could affect the future of each family member.

3. Use Information Sheet, Section III, to discuss consequences of a worker's using alcohol or drugs on the job.

   SUGGESTIONS:

   - Explain that alcohol or drug use on the job cannot be tolerated by employers because a drug or alcohol user becomes a safety threat to himself or herself and to fellow workers.
   - Explain the financial consequences of alcohol and drug use to the worker, to his or her family, and to the worker's company.
   - Quote appropriate statistics to support the ideas you have presented.
   - Make available to your students copies of the AGC publication *Guide to Drug-Free Jobsites*. Discuss in class.
   - Show the AGC videotape *Drug-Free Workplace*. Discuss in class.

SUGGESTED ACTIVITIES

4. Use Information Sheet, Section IV, to discuss job-safety rules.

SUGGESTIONS:

- Discuss OSHA and other regulatory acts and agencies.
- Show films *Safety in the Shop: Basic Practices*, *Housekeeping Means Safe Keeping*, and *How to Avoid 16 Leading Causes of OSHA Citations*.
- Demonstrate any safety procedures and explain any safety policies applicable to your specific equipment, shop, or job site.
- Ask students to explain why personal and job-safety rules are important. Have them list possible consequences of not following these rules.
- Stress the consequences of practical jokes on the job. Point out that employers do not want cheerless or humorless workers, but that they do want responsible employees who know the right time and place for humor. Explain how some people have lost their jobs because they engaged in horseplay or played practical jokes during working hours.
- Explain how horseplay and practical jokes around power equipment increase the possibility of accidents.
- Set up work schedules and shop clean-up procedures, and explain schedules and procedures to students. Post these schedules and procedures on the bulletin board.
- Explain procedures for disposing of waste and scrap materials.
- Discuss proper use of cleaning equipment and supplies, explaining special cleaning procedures or techniques specific to your equipment or shop.
- Use Supplement #2, "Properly Dressed Concrete Mason" and Supplement #3, "Types of Safety Equipment Used by Concrete Masons," to relate to students what a properly dressed concrete mason should wear, and then have students complete Assignment Sheet #1, "Identify Proper Dress for a Concrete Mason."
- Have students practice identifying job-site and shop safety violations by completing Assignment Sheet #2, "Visit a Job Site and Complete a Safety Checklist."
- Show films *A New Way to Lift*, *The Industrial Weightlifter II*, and *Danger Zone: Your Back*.
- Show students Transparency #1, "Correct Way to Lift Heavy Objects," and Supplement #4, "How to Lift Safely," and then have them complete Job Sheet #1, "Properly Lift a Heavy Object."

SUGGESTED ACTIVITIES

5. Use Information Sheet, Sections V and VI, to discuss safety precautions pertaining to scaffolds and ladders.

   SUGGESTIONS:

   - Discuss the precautions listed in the information sheet and have students study them. Show students copies of OSHA regulations pertaining to scaffolds and ladders.
   - Supplement your discussion with Transparencies #2, "Ladder Safety," and #3, "Ladder Danger."
   - Have one student set up a ladder while another student grades him or her on proper procedures.
   - Take a field trip to job sites where ladders and scaffolds are being used. Have students discuss proper safety rules they observe and any violations that they see.

6. Use Information Sheet, Section VII, to discuss the safety color code and its applications.

   SUGGESTIONS:

   - Ask if anyone in the class is colorblind (unable to distinguish between certain colors such as red and green). Take colorblind students on a special tour of the shop and work area, pointing out specific locations and applications for safety colors.
   - List colors of the safety color code, and have students find and list applications of each in the shop and at the work site.

7. Use Information Sheet, Section VIII, and Transparencies #4 through #7 to discuss classes of fires and types of fire extinguishers. Stress the importance of knowing the different classes of fires and the correct type of fire extinguisher to use for each.

   SUGGESTIONS:

   - Have students locate and read the labels on each of the fire extinguishers in the shop area, listing the class or classes of fire each should be used on.
   - Invite a fire fighter to the class to explain and to demonstrate the proper use of the various types of fire extinguishers.
   - Show film *Stop a Fire Before It Starts*.
   - Use International Fire Services Training Association transparencies and Transparencies #8 and #9 to explain the burning process.
   - Have students practice selecting the correct fire extinguisher by completing Assignment Sheet #3, "Match Fire-Extinguisher Symbols to Given Types of Fires."

SUGGESTED ACTIVITIES

8. Use Information Sheet, Section IX, to introduce students to terms and definitions associated with toxic substances.

   SUGGESTION:

   - Explain how knowing these terms and definitions should make students more aware of toxic substances and the importance of the safety rules pertaining to toxic substances.

9. Use Information Sheet, Sections X and XI, to discuss toxic substances a concrete mason may contact on the job and the forms of toxic substances.

   SUGGESTIONS:

   - Explain to the students the forms of toxic substances concrete masons commonly encounter on the job, and also how these substances may still be toxic, even when changed from their common form. For example, solids such as cement and asbestos are just as toxic when inhaled as airborne dusts.

   - Explain that solids are the least likely form to cause poisoning, but that when they are changed into another form they can be deadly, such as when welding rods decompose into fumes and gases, when burning plastics give off deadly gases, and when wood, concrete, and asbestos produce harmful dust.

   - Discuss how dust, gases, fumes, vapors, and mists can all be very dangerous when they enter the body through breathing, through the skin, or through open sores. Explain how some toxic substances may enter the body by settling on foods, drinks, and cigarettes, pipes, or cigars.

   - Explain how some toxic gases are easily detected by their distinctive smell or color, while some toxic gases have no smell or color.

   - Explain the different types of radiation that may be found on the job. Examples are ultraviolet light, infared rays, X rays, microwaves, and lasers. All of these are especially hazardous to the eyes. Warn students about these hazards, especially when working with or near welding procedures.

   - Take students on a field trip to a large construction site. Have them make a list of all the toxic substances they see plus any items that could be potential hazards if changed to another form, such as polyurethane foam burning.

SUGGESTED ACTIVITIES

10. Use Information Sheet, Sections XII through XIV, to explain ways toxic substances enter the body, the effects of toxic substances on the body, and the consequences of exposure to toxic substances.

    SUGGESTIONS:

    - Explain how the body quite often rids itself of toxic substances through sweat, breath, phlegm, vomit, sneezing, urine, and feces.
    - Discuss with the students how they may recognize symptoms of illness that result from exposure to toxic substances. Symptoms include headaches, itching, coughing, and loss of appetite.
    - Explain how some chemicals may only affect the bodily areas they contact while other chemicals may penetrate into one area of the body and then affect other bodily systems.
    - Discuss how most of the internal organs and the external organs—the skin, eyes, nose, and throat—can be damaged by toxic materials.
    - Explain how lack of knowledge of toxic substances could be very dangerous to the student, and how, by paying attention, students may save themselves and others from very painful and very dangerous situations.
    - Supplement your discussions with audiovisual programs on chemical hazards.

11. Have students complete Assignment Sheet #4, "Identify Job-Site and Shop Safety Violations."

12. Hand out copies of Supplement #5, "Sample Safety Forms" at your discretion. Have students read and complete the safety agreement, and then file. Have students complete the safety pledge, and then file.

(NOTE: It is highly recommended that a certified first-aid instructor be brought in to teach Sections XV through XXIX of this unit. The objectives listed in first-aid sections of this unit are to be used only as guidelines for the areas of first-aid instruction needed by a concrete mason, and they should not be considered definitive first-aid procedures. Also, first-aid procedures are often revised and updated, and the guidelines presented in this unit may quickly become out of date. Therefore, specific first-aid procedures need to be taught by a certified first-aid instructor.)

13. Use Information Sheet, Section XV, to introduce students to terms and definitions associated with first aid.

    SUGGESTIONS:

    - Explain how knowing these terms and definitions will help students understand and grasp the importance of first aid.

SUGGESTED ACTIVITIES

- Have students review terms associated with first aid by completing Supplement #1, "Safety and First-Aid Crossword Puzzle."

- Whenever possible show students examples of the different terms used in first aid.

14. Discuss Information Sheet, Section XVI, stressing the importance of knowing first aid.

SUGGESTIONS:

- Supplement your discussion with material from the American Red Cross books *Standard First Aid and Personal Safety* and *Multimedia Standard First Aid Student Workbook*. Encourage students to obtain their own copies of these manuals for home and work-site reference. Both manuals are available from the American Red Cross, 17th and D Streets, Washington, D.C. 20006.

- Show films *An Option to See*, *Don't Push Your Luck*, *It's Up to You*, and *On Every Hand*.

- Invite a resource person to speak to the class on first-aid techniques.

- Encourage students to take American Red Cross cardiopulmonary resuscitation (CPR) and first-aid courses for certification.

- Tell students the local number for emergency medical service.

15. Use Information Sheet, Section XVII, to discuss concrete masonry job-related injuries that may require the administration of first aid.

SUGGESTIONS:

- Discuss how many of the job-related injuries listed may require CPR. Demonstrate CPR and have students complete the appropriate section of Job Sheet #2.

- Discuss first-aid treatment for poisoning victims, and then have students complete appropriate section of Job Sheet #2.

16. Use Information Sheet, Section XVIII, to discuss the order to follow when giving first aid in an emergency.

SUGGESTION:

- Hand out Supplement #6, "General Directions for Giving First Aid."

SUGGESTED ACTIVITIES

17. Use Information Sheet, Section XIX, to discuss traumatic shock, stressing that traumatic shock can be life-threatening unless treated.

    SUGGESTIONS:

    - Demonstrate and discuss the procedure for treating traumatic shock as outlined in Job Sheet #2, Section III, Steps G and H.
    - Have students complete the appropriate section of Job Sheet #2.

18. Discuss Information Sheet, Sections XX and XXI, stressing prevention of heat stroke and heat exhaustion.

    SUGGESTIONS:

    - Use Transparency #10, "Face and Skin Conditions in Heat Stroke and Heat Exhaustion," to illustrate your discussion.
    - Make copies of Supplement #7, "How to Beat the Heat," to post on the bulletin board or to hand out to students for future reference, and discuss.
    - Discuss the need to drink plenty of water to prevent dehydration and possible heat stroke or heat exhaustion. Water is a better drink than sweet or electrolyte drinks because water leaves the stomach faster and is more quickly available for the tissues. Also discuss the need for increasing one's salt intake and eating a balanced diet. Using a little extra table salt can help replace sodium and chloride lost through heavy perspiration. Salt tablets are not recommended. A balanced diet of whole-grain cereals, fruits, vegetables, milk, meat, poultry, and fish will supply potassium and other mineral elements lost through heavy perspiration.
    - Have students complete the appropriate section of Job Sheet #2.

19. Discuss Information Sheet, Sections XXII and XXIII, to explain measures to take to prevent frostbite and symptoms of frostbite.

    SUGGESTIONS:

    - Explain different methods used to prevent frostbite. Discuss how wearing proper clothes such as winter-weight shoes, gloves, and ear and face protection will prevent frostbite.
    - Explain how important it is to carry extra clothing during the cold seasons because you may need to add clothing if the temperature drops, or if you get wet, you may need to change clothes completely.
    - Discuss with the students how to detect frostbite, also relate to them how the affected parts get numb and the joints are stiff and do not function properly. Explain how painful it is when the feeling starts returning to frostbite-affected parts.
    - Discuss treatments of frostbite. Then have students complete the appropriate section of Job Sheet #2 by pairing off and having one student administer first aid to another student pretending to be a frostbite victim. Then have the students switch places.

SUGGESTED ACTIVITIES

20. Use Information Sheet, Section XXIV, to explain the correct pressure points to use to control bleeding.

SUGGESTIONS:

- Remind students that pressure points are used *only* when bleeding cannot be controlled by direct pressure.
- Relate incidents from your experience or give case studies to illustrate the importance of controlling bleeding by direct pressure.
- Remind students that bleeding victims should be observed for signs of traumatic shock and treated accordingly.
- Explain the difference between arterial and venous bleeding: *arterial bleeding* is bright red and spurts or flows intermittently; *venous bleeding* is dark red and flows continuously. Immediate steps must be taken to stop arterial blood flow, as this is a life-threatening situation. Often, even heavy pressure to a pressure point is ineffective in stopping arterial bleeding. In such cases, the severed artery must be found and pinched closed with the fingers. Direct pressure is usually effective in controlling venous bleeding.
- Demonstrate the steps for controlling bleeding by direct pressure as outlined in Job Sheet #2. Have students practice applying pressure to simulated bleeding (both arterial and venous) on various parts of the body by completing the appropriate section of Job Sheet #2.
- Caution students that tourniquets are used ONLY as a last resort. Explain that while a tourniquet may be necessary to save a person's life, it cuts off circulation and may cost the victim his or her limb. Stress that if a tourniquet must be used, the victim must be seen by a physician as soon as possible and a note must be attached to the victim with the time of tourniquet application noted.
- Explain what to do if a victim has severed a finger, hand, or limb. Tell students that bleeding should be controlled by applying pressure to the correct pressure point, and that the severed appendage should be wrapped in a clean cloth or placed in a clean plastic bag and be transported to the hospital with the victim. If possible, the appendage should also be kept cool with ice; but the ice must not be allowed to directly touch the appendage.

21. Use Information Sheet, Section XXV, to discuss symptoms of first-, second-, and third-degree burns.

SUGGESTIONS:

- Stress that immediate care of a burn victim may be the deciding factor in the severity of the injury.

SUGGESTED ACTIVITIES

- Point out situations and areas of the shop and work site where there is potential for workers to receive burns.

- Demonstrate and have students complete the appropriate section of Job Sheet #2.

22. Use Information Sheet, Section XXVI, to discuss the guidelines for administering first aid to a victim with an eye injury.

    SUGGESTIONS:

    - Show the film *Eye Injuries*.

    - Stress that the whole eye may be damaged in a serious injury and that vision may be lost. The sooner care is obtained, the greater the chances for saving the victim's sight.

    - Demonstrate and have students complete the appropriate section of Job Sheet #2.

23. Use Information Sheet, Sections XXVII and XXVIII, to discuss signs and symptoms of fractures and guidelines for administering first aid to a victim with a suspected fracture.

    SUGGESTIONS:

    - Discuss the differences between open and closed fractures, both in treatment and signs and symptoms.

    - Remind students that when they cannot tell whether a person is suffering from a fracture or a sprain they should always assume that the injury is a fracture and treat it as such.

    - Invite a member of the local Red Cross chapter to come to class to demonstrate different types of splints and splinting techniques. Have this person also demonstrate correct procedures for immobilizing a person with a suspected neck or back fracture.

    - Demonstrate and have students complete the appropriate section of Job Sheet #2.

24. Show or display any other audiovisuals you think are appropriate.

SUGGESTED ACTIVITIES

25. Have students complete Assignment Sheet #5, "Analyze Case Studies to Determine Correct First-Aid Treatments."

    (NOTE: Assignment Sheet #5 should be given to students only after they have reviewed the information sheet and completed the job sheets and other assignment sheets. It should be treated as a practice exercise where students apply the knowledge they have gained from the entire training program.)

G. Post appropriate warning signs and operating procedures near equipment.

H. Caution students that noncompliance with safety rules will result in disciplinary action.

I. Urge students to read and use supplements furnished with this unit.

J. Give test.

K. Critique test and discuss in class.

L. Reteach and retest if necessary.

M. Complete appropriate section of competency profiles.

III. Unit references

A. *Accident Prevention Manual for Industrial Operations*, 7th ed. Chicago, Illinois: National Safety Council, 1974.

B. American Red Cross. *Standard First Aid and Personal Safety*, 2nd ed. Garden City, New York: Doubleday and Company, Inc., 1979.

C. *An Accident Prevention Program for Schools, Shops, and Laboratories*. State College, Pennsylvania: Department of Vocational Education/Pennsylvania State University, 1983.

D. Carlson, Gene P., and William J. Vandervort, eds. *Essentials of Fire Fighting*, 2nd ed. Stillwater, Oklahoma: Fire Protection Publications, Oklahoma State University, 1983.

E. *Federal Register*, Vol. 36, No. 105, Pt. 2. Washington, D.C.: United States Department of Labor, May 29, 1971.

F. *First Aid*. Washington, D.C.: United States Department of Labor, Bureau of Mines, 1978.

G. Hendrix, Laborn J. "Bud." *Fundamentals of Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1985.

H. Hendrix, Laborn J. "Bud." *Heavy Equipment Operator Instructional Materials, Basic Core*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1981.

SUGGESTED ACTIVITIES

I. *Manual of Accident Prevention in Construction.* Washington, D.C.: The Associated General Contractors of America, 1971.

J. Polivchak, Philip, and Gilbert Wolf. *Incentive Apprenticeship Training for Cement Masons.* Washington, D.C.: National Association of Home Builders, Manpower Development and Training Department, 1979.

K. *Rubber-Tired Front End Loader and Forklift Truck Accident Prevention*, Mesa Instruction Guide 30. Washington, D.C.: United States Department of the Interior, Mining Enforcement and Safety Administration, 1975.

L. *Safety and Health Training Program*, Vols. I and II. Washington, D.C.: Operative Plasters and Cement Masons International Association, n.d.

M. "Safety Forms." Pleasanton, California: Northern California Cement Masons Joint Apprenticeship and Training Committee, n.d.

N. *Safety Practices and Procedures in School Shops.* Trenton, New Jersey: Department of Education/Division of Vocational Education, n.d.

O. Smith, Earl. *Power Line Technician.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1978.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — SAFETY AND FIRST-AID CROSSWORD PUZZLE

Test yourself on safety and first-aid terminology by using the clues below to complete the crossword puzzle on the following page. Clue 57 Down has been done for you.

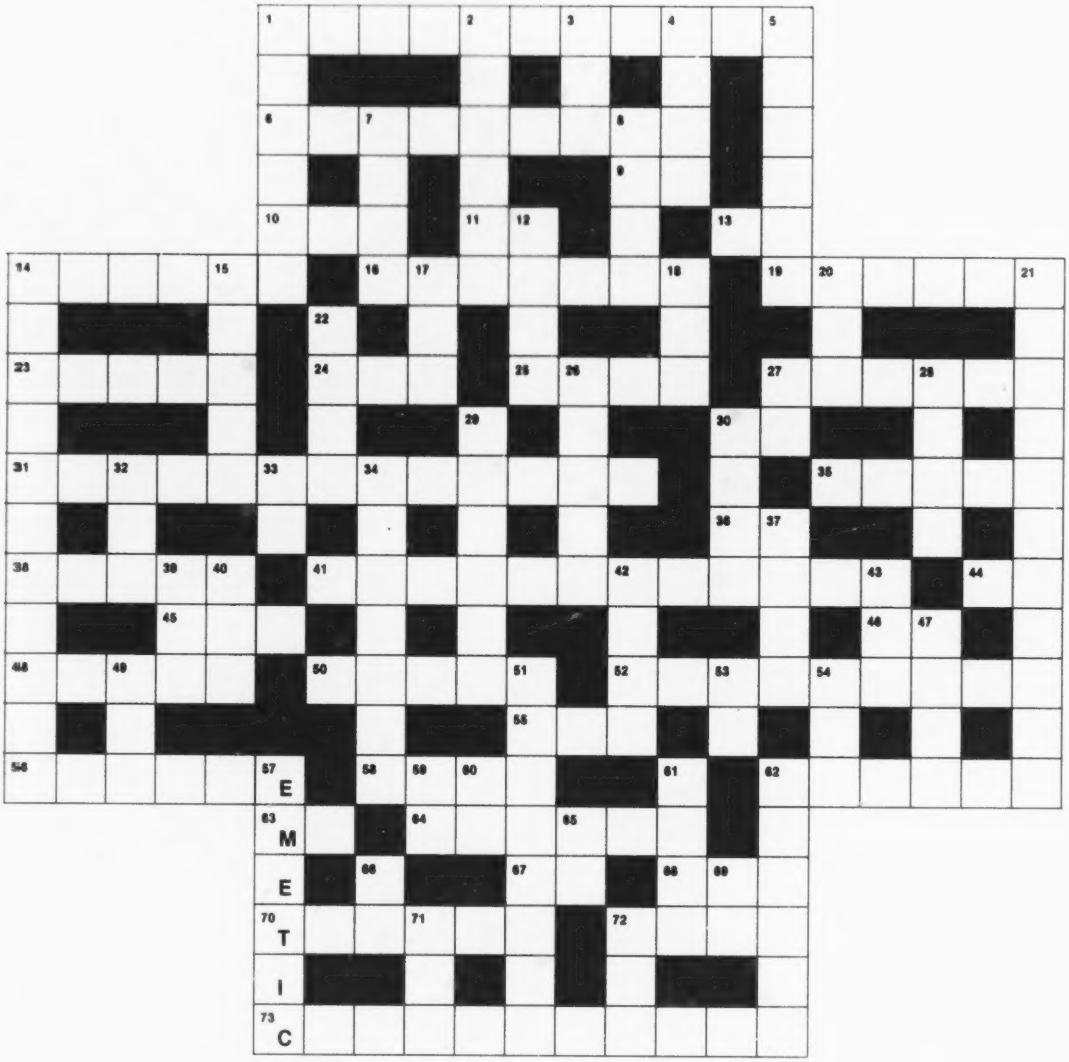
ACROSS

1. Guidelines for job safety (2 wds.)
6. Suddenly occurring unintentional events that cause injury or property damage
9. Exists
10. Long, thin fish
11. Northwest Territories (abbr.)
13. Atop
14. Source of danger
16. Intensity indicators for first-, second-, and third-
19. Muscular organ in mouth
23. Combustible substance in Class D fire
24. Cardiopulmonary resuscitation (abbr.)
25. Fracture associated with open wound
27. Explode; burst violently
30. "To be or not to. . ."
31. Act of reviving a person by bringing person back to full consciousness
35. Common blood group
36. Route (abbr.)
38. Substance in fire extinguisher used on Class A and Class B fires
41. Negligence; failure to think before one acts
44. 101 Roman
45. Word of negation
46. Pennsylvania (abbr.)
48. Federal safety color designating location of first-aid equipment
50. Indication of fire
52. Capable of being easily ignited
55. Untruth
56. Life-threatening disorder caused by prolonged exposure to intense heat
58. Tender; painful
62. Freedom form danger, risk, or injury
63. Physician's degree
64. Resuscitate
67. Article
68. Health resort with mineral springs
70. Complaint of victim in shock from hemorrhage
72. Wound made by piercing with a sharp instrument
73. Capable of bursting into flames

DOWN

1. What all metal containers for flammable materials should be
2. "Good ------s to all"
3. The worst thing to do if your clothing or hair catches fire
4. Shock can be caused by ---- of blood
5. Device to prevent fractured bones and adjacent joints from moving
7. Water temperature for treatment of second-degree burns
8. To become in need of rest; to become weary
12. Group of three
14. Heavy loss of blood
15. Guidelines
17. Organ of hearing
18. Cause of 56 Across
20. Flammable liquid
21. Violently and loudly
22. 1151 Roman
26. What one should never do to an open fracture
27. State-of-being verb
28. ---- up spills immediately
29. Long, thin mark of different color than surrounding area
30. Injury caused by contact with heat, steam, electricity, or flame
32. Spanish word for 18 Down
33. Cubic centimeter (abbr.)
34. Bodily injuries, wounds, or shock
37. Group that works together toward a common goal
39. Unit
40. Prefix meaning *not*
42. Free of danger; secure
43. Identical twin of 68 Across
47. Capable
49. Ever (poetic)
51. Raises, as for an injured or bleeding limb
53. Fire extinguisher to use on flammable liquids and ordinary combustibles
54. Actress Farrow
57. Substance used to cause vomiting of some poisons
59. Either –; neither, nor
60. Prefix meaning again
61. Inactivity after work or exertion
62. Not changing
65. Within; inside
66. Prefix meaning *two*
69. Father (slang)
71. Action that eases heat cramps
72. Science fiction; --fi

SUPPLEMENT #1



FCCM - 179-A

SUPPLEMENT #1

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14 H	A	Z	A	15 R	D	■	16 D	17 E	G	R	E	E	18 S	■	19 T	20 O	N	G	U	21 E
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31 R	E	32 S	U	S	33 C	I	34 T	A	T	I	O	N	■	U	■	35 T	Y	P	E	O
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38 H	A	L	39 O	40 N	■	41 C	A	R	E	L	E	42 S	S	N	E	S	43 S	■	44 C	I
A	■	■	45 N	O	T	■	U	■	A	■	■	A	■	■	A	■	46 P	47 A	■	V
48 G	R	49 E	E	N	■	50 S	M	O	K	51 E	■	52 F	L	53 A	M	54 M	A	B	L	E
E	■	E	■	■	■	■	A	■	■	55 L	I	E	■	B	■	I	■	L	■	L
56 S	T	R	O	K	57 E	■	58 S	59 O	60 R	E	■	■	61 R	■	62 S	A	F	E	T	Y
					63 M	D	■	64 R	E	V	65 I	V	E	■	T					
					E	■	66 B	■	■	67 A	N	■	68 S	69 P	A					
					70 T	H	I	71 R	S	T	■	72 S	T	A	B					
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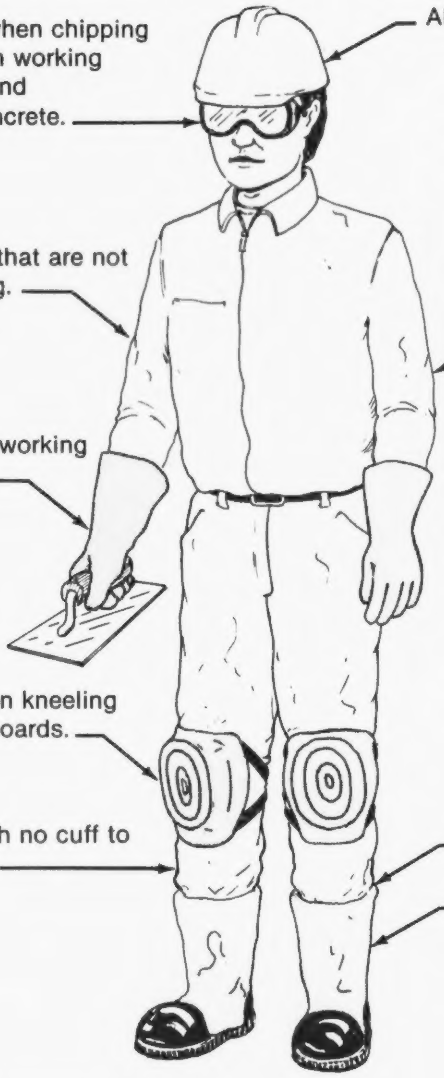
					73 C	O	M	B	U	S	T	I	B	L	E					

SUGGESTED ACTIVITIES

SUPPLEMENT #2 — PROPERLY DRESSED CONCRETE MASON

The properly dressed concrete mason—



Wears goggles when chipping or grinding, when working around chutes, and when mixing concrete.

Always wears a hard hat.

Wears clothes that are not too loose-fitting.

Wears long-sleeved shirts to give extra protection if skin is sensitive.

Wears gloves when working with wet concrete.

Wears kneepads when kneeling on concrete or kneeboards.

Wears pants with no cuff to catch concrete.

Wears pants tucked into boots.

When wading in concrete, wears loose boots that are easy to slip on and off and are high enough to keep out wet concrete.

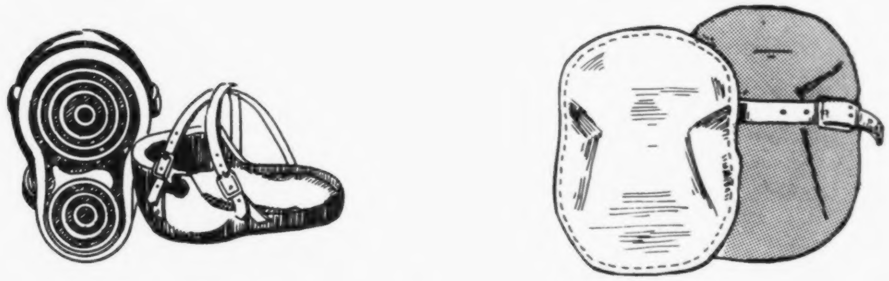
Keeps gloves and clothing as dry as possible.

Adapted with permission of the National Apprenticeship Program.

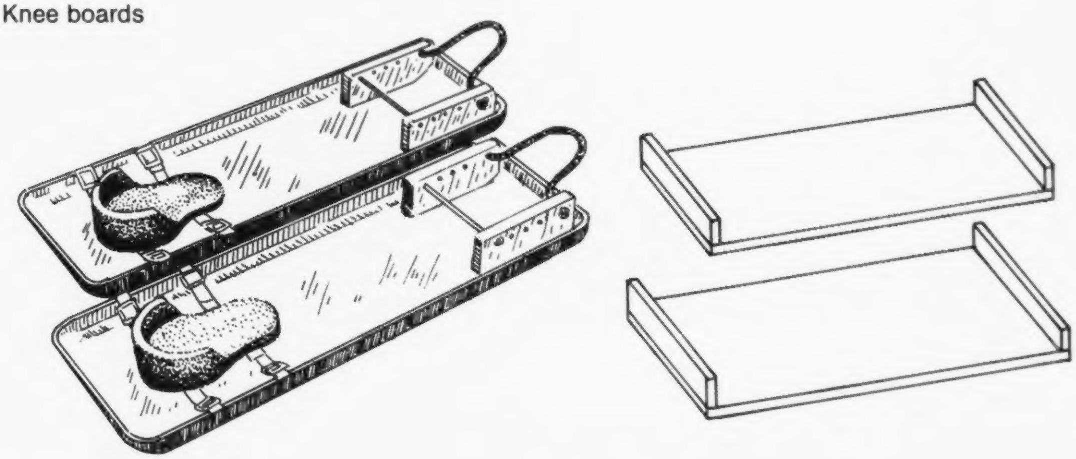
SUGGESTED ACTIVITIES

SUPPLEMENT #3 — TYPES OF SAFETY EQUIPMENT USED BY CONCRETE MASONS

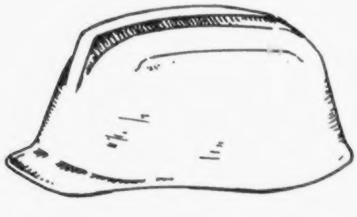
Knee pads



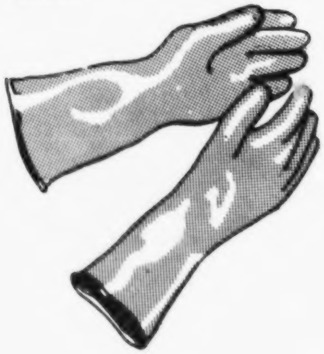
Knee boards



Safety helmet/hard hat

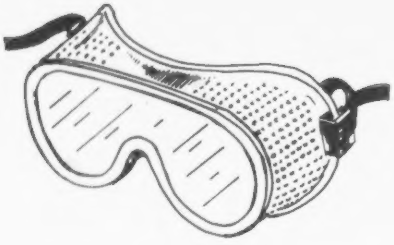


Rubber gloves

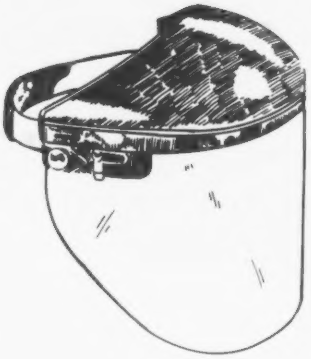


SUPPLEMENT #3

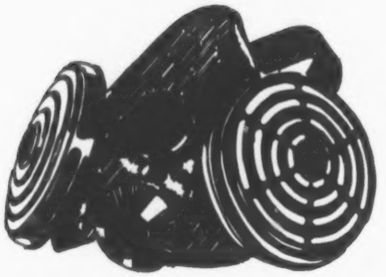
Goggles

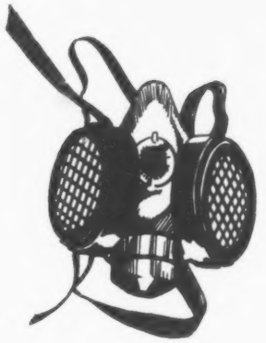


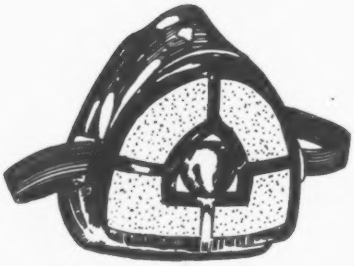
Face shield



Respirators

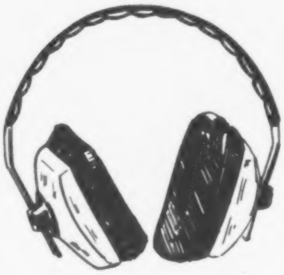


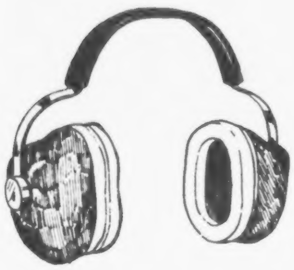


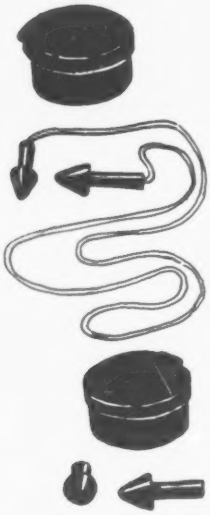


SUPPLEMENT #3

Ear protectors





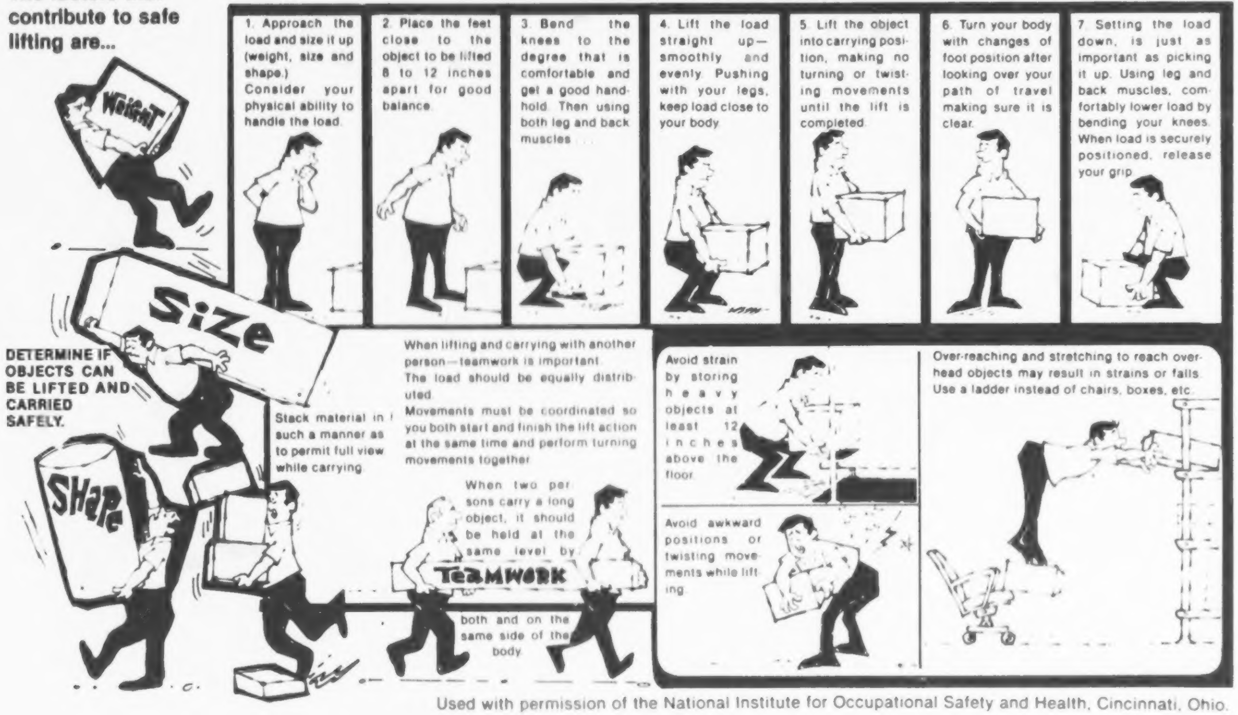


SUGGESTED ACTIVITIES

SUPPLEMENT #4 — HOW TO LIFT SAFELY

HOW TO LIFT SAFELY

The following safe practices should be observed in order to avoid injury.



The factors that contribute to safe lifting are...

DETERMINE IF OBJECTS CAN BE LIFTED AND CARRIED SAFELY.

1. Approach the load and size it up (weight, size and shape.) Consider your physical ability to handle the load.

2. Place the feet close to the object to be lifted 8 to 12 inches apart for good balance.

3. Bend the knees to the degree that is comfortable and get a good hand-hold. Then using both leg and back muscles . . .

4. Lift the load straight up—smoothly and evenly. Pushing with your legs, keep load close to your body.

5. Lift the object into carrying position, making no turning or twisting movements until the lift is completed.

6. Turn your body with changes of foot position after looking over your path of travel making sure it is clear.

7. Setting the load down, is just as important as picking it up. Using leg and back muscles, comfortably lower load by bending your knees. When load is securely positioned, release your grip.

Stack material in such a manner as to permit full view while carrying.

When lifting and carrying with another person—teamwork is important.
The load should be equally distributed.
Movements must be coordinated so you both start and finish the lift action at the same time and perform turning movements together.

When two persons carry a long object, it should be held at the same level by both and on the same side of the body.

Avoid strain by storing heavy objects at least 12 inches above the floor.

Avoid awkward positions or twisting movements while lifting.

Over-reaching and stretching to reach overhead objects may result in strains or falls. Use a ladder instead of chairs, boxes, etc.

Used with permission of the National Institute for Occupational Safety and Health, Cincinnati, Ohio.

SUGGESTED ACTIVITIES

SUPPLEMENT #5 — SAMPLE SAFETY FORMS

Safety Agreement

Subcommittee: ______________________________

Instructor: ______________________________

Re: Code of Safe Practices

This will acknowledge my receipt of

1. A printed copy of the "Code of Safe Practices" and
2. A printed copy of the "Code of Safe Practices and Operations."

In consideration of my acceptance into the Apprenticeship and Training Program, I acknowledge that I have read the foregoing documents and know and understand the contents thereof and, further, that I have had an opportunity to discuss same with my instructor prior to the execution of this document.

Signed at ____________________, ____________________
(CITY) (STATE)

this ____________________ of ____________________, 198______.
(DAY) (MONTH)

____
(SIGNATURE)

____
(NAME — Please print)

"Safety Agreement," "Code of Safe Practices," and "Code of Safe Practices and Operations" adapted with permission of the Northern California Joint Apprenticeship and Training Committee, Pleasanton, California.

SUPPLEMENT #5

Code of Safe Practices

Accident prevention — All persons must abide by OSHA safety standards, general industry safety orders, and company rules. Posters and other safety materials are displayed for the benefit of the employee; read and abide by these suggestions. Give every possible aid in the event of injury.

Job site — Keep work areas free of debris. Good housekeeping is essential. Remove or correct any hazards. Never work or pass under suspended load or equipment.

Work habits — Assist other trades when necessary to maintain safe operations. Never place yourself in a dangerous position or allow others to work in a dangerous position. Use the right tool or equipment for all work. Never use any alcoholic beverage on the job. Do not be a party to horseplay; pranks can be fatal. Construction sites offer unusual hazards; walk and work with all due respect for those hazards.

Hand tools — Always use the proper tools and maintain them in good condition. Never use tools with loose or broken handles, mushroom heads, or dull blades. Always use the correct size or type of tool for the job.

Power tools — Never use a powder-activated tool unless you have been licensed. Know the proper method of using a skill saw; never block back the retractable guard; it is for your protection. Never use a tool with which you are not fully experienced.

Materials-handling — Lift with the leg muscles; do not bend over and lift with your back. Learn and practice the proper way to lift or carry material or any object. Do not operate any type of powered materials-handling or hoisting equipment unless authorized. Get help in handling heavy or bulky loads.

Protective devices — Handrails, guardrails, protective covers, toeboards, ramps, and safety devices installed on various tools are there for your safety; do not tamper with, remove, or damage these protective devices. Replace, correct, or report any unsafe guard or device.

Electrical — Respect electricity under all circumstances. Never use electrical equipment in areas of excessive moisture unless you have taken all safeguards. Approved electric power tools and extensions are grounded; never alter cords or plugs.

Underground — Never enter any underground vault, manhole, silo, or any enclosed area until you are certain that the air within contains no flammable, contaminated, or toxic vapor or gas. Thoroughly test, ventilate, or wear adequate protective gear before entering enclosed areas.

Transportation — When transportation is necessary in other than a passenger vehicle, ride or sit in the cab; do not stand on the bed of a truck; never ride with arms or legs over the sides. Do not sit on the tailgate; it must be closed during transportation of passengers. Be careful of any tools, materials, or equipment within the truck body that may shift or slide and cause injury.

Flammables, solvents — Never use gasoline or other highly volatile liquids for cleaning purposes. Oxygen and acetylene cylinders can be dangerous; secure them against rolling or tipping. Handle carefully any tanks or containers that contain explosive vapor or liquid, and never expose these containers to open flame or spark.

SUPPLEMENT #5

Personal protection — Stay clear of heavy earth-moving equipment. Remain aware of warning devices such as bells, horns, or whistles. Hard hats are mandatory; always wear one on any construction job. Use other protective gear as recommended when exposed to unusual hazards. Never attempt an operation with which you are not familiar; ask first for specific instructions. Wear suitable work clothes at all times. Wear heavy-soled shoes; they protect you against a puncture injury.

First aid — Basic first aid is of value in the event of injury. Know how to give first aid; it may save a fellow worker from death. Unless you completely understand the proper method, never attempt to move a person who is possibly suffering from an injured spine or other internal injury.

Safety meetings — Tool-box meetings are held for a purpose. Attend willingly and participate by offering ideas to develop accident-free job sites. Accept advice offered by others who may be more experienced.

Accident reporting — Immediately report all personal injuries. Obtain authorization for any medical attention off the job. Medical release is necessary before returning to work.

SUPPLEMENT #5

Code of Safe Practices and Operations

General safety

1. Be alert for unsafe work methods or unsafe conditions, and either correct them or report them to your supervisor immediately.
2. Immediately report every injury—whether serious or not—to your boss.
3. Do not drink alcohol or take narcotics or habit-forming drugs in any form just before or during work hours.
4. Do not participate in horseplay, practical jokes, or sparring; they cause accidents.
5. A good night's sleep and good food make you feel better and help you avoid accidents. Get your share of sleep and good food.

Dos and don'ts

1. Do not work without a hard hat.
2. Do not work without proper eye protection.
3. Do not work without an approved protective respirator.
4. Do not work without proper footwear.
5. Do not work without proper protective clothing.
6. Do bend all exposed nails and staples.
7. Do keep work area clean and free of debris, and secure all air, water, and electric lines so that they do not become tripping hazards.
8. Do not use electrical equipment in a wet or damp area.
9. Do not leave electrical wires or equipment in water.
10. When filing trowels, do lay file on a flat surface, and while holding the trowel by the handle, stroke the trowel edge on the file.
11. Do not use wet extension handles around electrical equipment or power lines.
12. Do not use metal extension handles; they are illegal. This applies to metal extensions affixed to bull floats or fresnos.
13. Do use safety belts where necessary, and be sure safety belts are tied off at an area free of the work platform.
14. Do not overreach when working from of a ladder.

SUPPLEMENT #5

15. Do wash your hands before eating or drinking.
16. Do not drink water from a concrete tank.
17. Do not contaminate water cans.
18. Do make sure all accidents and injuries are reported immediately to your supervisor.
19. Do not enter an unsafe work area. Report any unsafe area to your supervisor.
20. Do remember that you can be taken off the job for violating safety rules, for working under unsafe conditions, or for causing an unsafe condition.
21. Do not bypass any safeguards.
22. Do report any unsafe condition to your supervisor.
23. When working around epoxy-based material, do wear protective clothing and a properly filtered respirator.
24. Do not work in a confined area where gasoline-driven equipment is running unless proper ventilation is supplied.
25. When working in an excavation, do be alert for sliding soil and falling rocks, and be certain that trenching and excavating are properly shored.
26. *At all times*, do be alert for any equipment moving near you.
27. Do *be doubly alert* and throughly examine all shoring after a rainfall.
28. Tailgate safety meetings are for your protection and education; do be sure you attend and pay attention.

Slips and falls

More people are injured in slips and falls than in any other type of accident. Follow these safe practices to prevent slips and falls.

1. Wear safe, strong shoes that are in good repair.
2. Watch where you step. Be sure your footing is secure.
3. Do not allow yourself to get in an awkward position. Stay in control of your movements at all times.
4. Maintain clean, smooth walking and working surfaces. Fill holes, ruts, and cracks; clean up slippery material.

SUPPLEMENT #5

5. Pick up litter. Do not allow tripping hazards to exist.
6. Install cables, extension cords, and hoses so that they will not become tripping hazards.
7. If you must climb to reach something, use a sound ladder that has been safely set in position and properly secured at both top and bottom. Use only Type I industrial ladders.
8. When climbing a ladder, always face the ladder and use both hands.
9. When reaching from a ladder, keep your shoulder inside the vertical stringer. Do not overreach; move the ladder.
10. Walk, don't run.
11. Construct and use only safe scaffolds. If a scaffold is wobbly or bouncy, or can be pulled down easily, it is not safe. A scaffold should have a sound structure and have toeboards and handrails. A scaffold's wooden floor planks must be free of knots, and broken members must be repaired immediately.
12. Scaffolding must have component parts consisting of toprails that are 42 inches above platform and a midrail and a toeboard that are a minimum of 4 inches high and located no higher than 1/4 inch above the platform. Platforms must be planked solid. Your supervisor will give you further specifications for properly erecting and using scaffolding.

Materials-handling

Every concrete mason handles materials. It is easier and faster to handle materials the safe way. The following practices will help you move materials safely.

1. Do not move an object twice if once will do. Plan your work.
2. Do not try to lift objects that may be beyond your physical capacity and training. Get help, or use a machine or hand truck.
3. Use gloves, aprons, or pads when handling materials that are rough, sharp, hot or cold, or covered with hazardous substances.
4. While moving a load, be sure you can see where you are going.
5. When carrying long objects such as pipe or lumber, keep the leading end of the object above your head height and the trailing end close to the ground.
6. When lifting heavy objects from the floor, kneel on one knee, roll or tip the object onto the other knee, then pull the load next to your stomach and stand up. Use the reverse procedure to put down a load. Remember: Your back is not made of steel.
7. Pile material on a strong, level base. Interlock material so the pile will not come apart. Chock around stock so it cannot roll.

SUPPLEMENT #5

Hand tools

Good workers can be recognized by the tools they keep.

1. Dress cutting tools at the proper angle and keep them sharp. Keep cutting tools in a scabbard—not in your pocket. Store cutting tools in a safe place.
2. Dress the heads of most striking tools so they are square and without burrs.
3. Use the right kind of tool. Use the right size tool. Remember: A screwdriver is not a punch or chisel, a file is not a pry bar, a wrench is not a hammer, and a Stilson wrench is not a crescent wrench.
4. Hold screwdrivers, wrenches, chisels, etc., in such a way that you will not be hurt if there is a slip or a miss.
5. Do not use a file unless it has a handle.
6. Remember: If you use the proper tool for the job, the job will not require as much muscle power.

Portable power tools

1. Electrically ground every electric power tool before you use it.
2. Check the insulation on cords and the condition of plugs and sockets every day. If cords, plugs, or sockets are frayed, worn, cut, or broken, repair them before using.
3. String temporary extension cords and power lines so they will not create a tripping hazard and so they are protected from physical damage.
4. Do not use a skill saw unless the guard is in safe working condition.
5. Before using a drill on a wall, floor, or ceiling, be sure electric wires, gas lines, and high-pressure lines are not in the way.
6. Do not use cartridge tools for driving nails or spikes in walls, ceilings, or floors when people are working on the other side.

Power machinery

Remember: An unguarded hazardous piece of machinery will eventually injure someone.

1. Use machinery only when you have been authorized to do so and when you have received safety instructions.
2. Do not operate any machine unless its guards are in place.
3. If you see an unguarded machine, report it at once.

SUPPLEMENT #5

4. Be sure guards are safe. A *safe* guard covers all moving parts and is designed to permit safe oiling and adjustment.

5. If you must remove a guard, stop the machine, lock the switch, and tag the machine so another worker cannot start it.

6. Do not bypass two-handed controls or otherwise make them ineffective.

7. Loose clothing is easily caught in machinery. Loose sleeves, ties, and aprons are taboo on the job. Wrist watches, rings, and other jewelry are also taboo.

8. Use goggles, gloves, or any other protective equipment required by the job.

Chemicals

1. Know the hazardous properties of the chemicals you work with.

2. Read labels on containers and follow the manufacturer's instructions to the letter.

3. Know the first-aid treatment for any chemical you work with, and be prepared to carry out that treatment immediately if need be.

4. Store chemicals in a safe manner and according to the manufacturer's recommendations.

5. Keep chemical containers closed when not in use.

6. At regular intervals, inspect containers and pipelines that hold corrosive materials. Report leaks immediately.

7. When using corrosive materials, know where the closest shower and eye fountain are located. Keep the shower and eye fountain unobstructed and in good working condition at all times.

8. Use gas mask, goggles, gloves, and protective equipment as required.

SUPPLEMENT #5

Safety Pledge

Safety Pledge

It is understood that each student/employee will be given instruction in the use of the equipment and in the correct safety procedures concerning the equipment before she or he will be allowed to operate it. The student/employee must assume responsibility for following safe practices. We, therefore, ask that the student/employee subscribe to the following safety pledge.

> **I will follow all safety rules.**
>
> **I will never use a machine without first having permission from my instructor or supervisor.**
>
> **I will not ask permission to use a particular machine unless I have been instructed in its use and have scored 100 percent on the safety test for that machine.**
>
> **I will report immediately any accident or injury, no matter how minor, to my instructor or supervisor.**

Student's/employee's signature ______________________________ Date __________

Manager's signature ______________________________ Date __________

Supervisor's or instructor's signature ______________________________ Date __________

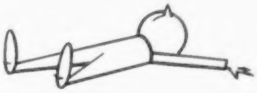
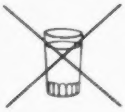
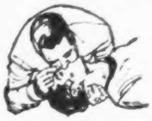
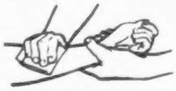
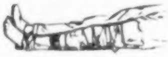
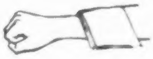
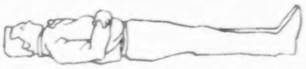
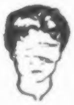
Parent's or guardian's signature ______________________________ Date __________

(Parental consent is necessary if the student/employee is under 18.)

SUGGESTED ACTIVITIES

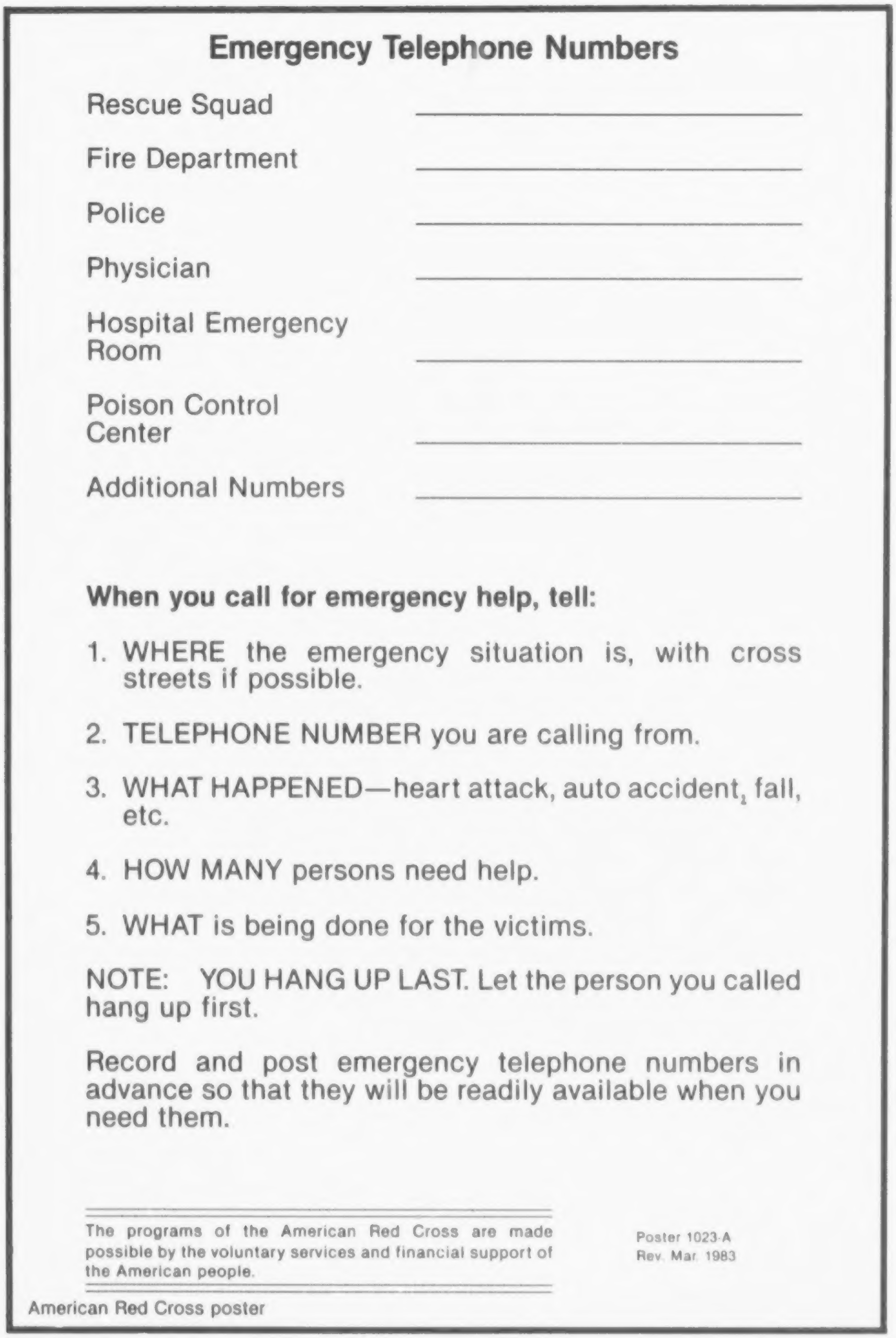
SUPPLEMENT #6 — GENERAL DIRECTIONS FOR GIVING FIRST AID

American
Red Cross

Keep the injured person lying down.  **Do not give liquids to an unconscious person.**  **Restart breathing with mouth-to-mouth artificial respiration.**  **Control bleeding by pressing on the wound.**  **Dilute swallowed poisons** **and call the Poison Control Center. Keep broken bones from moving.**  **Cover burns with thick layers of cloth.**  **Keep heart-attack cases quiet and give cardiopulmonary resuscitation (CPR) if it is necessary** **and if you have been trained. Keep a fainting victim lying flat.**  **For eye injuries, pad and bandage both eyes.**  **Always call a doctor.**

For more information about these and other lifesaving techniques, contact your Red Cross chapter.

SUPPLEMENT #6



Emergency Telephone Numbers

Rescue Squad ______________________

Fire Department ______________________

Police ______________________

Physician ______________________

Hospital Emergency Room ______________________

Poison Control Center ______________________

Additional Numbers ______________________

When you call for emergency help, tell:

1. WHERE the emergency situation is, with cross streets if possible.
2. TELEPHONE NUMBER you are calling from.
3. WHAT HAPPENED—heart attack, auto accident, fall, etc.
4. HOW MANY persons need help.
5. WHAT is being done for the victims.

NOTE: YOU HANG UP LAST. Let the person you called hang up first.

Record and post emergency telephone numbers in advance so that they will be readily available when you need them.

The programs of the American Red Cross are made possible by the voluntary services and financial support of the American people.

Poster 1023-A
Rev. Mar. 1983

American Red Cross poster

SUGGESTED ACTIVITIES

SUPPLEMENT #7 — HOW TO BEAT THE HEAT

HOW TO BEAT THE HEAT

Reactions to hot weather vary with a person's age, general physical condition, and activity level. Older people, small children and very active young people are the most likely to suffer from heat illness.

The human body is capable of adapting itself to varying temperature conditions, but the combined effect of heat and heavy physical exertion may be too much for the body's natural temperature regulator. Heat can make some people sick, and in some cases, it can kill.

Here's what happens. The body itself produces metabolic heat — more heat when you're working or playing than when resting. Outdoors on a sunny day, radiant energy adds heat to the body. If the air is warmer than the body temperature, more heat may be added.

The body's heat regulation system tries to maintain a fairly constant temperature of about 98°F. To cool the body, the heart pumps blood out to the extremities—arms and legs—where the heat is dispersed. Another way the body eliminates heat is through the cooling evaporation of sweat. A cool breeze and low humidity help body cooling. High humidity interferes with sweating and adds to discomfort.

Some of the more common forms of heat illness are as follows:

HEAT SYNCOPY OR HEAT FAINTING

This is common among people who are not acclimated to hot weather. It normally occurs soon after someone goes out into the heat to work or exercise. The blood pressure falls suddenly as blood flows to the extremities to cool the body and not enough goes to the head. The person feels giddy, light headed and then passes out. The best first aid is to have the person lie down to rest and elevate the feet.

HEAT CRAMPS

These muscular cramps result from exposure to high temperatures for a relatively long period of time, coupled with physical exertion. Heavy sweating and dehydration usually precede the cramps.

HEAT EXHAUSTION

This occurs after some hours in the sun and is related to loss of water and salt through sweating without sufficient fluid replacement. Common symptoms include a subnormal body temperature; pallor; dizziness; profuse sweating; cool, moist skin; nausea and headaches. The best first aid is to have the person rest in a cool place and drink water or fruit juice. If the person doesn't feel better in an hour or two or can't hold liquids, take him/her to a hospital emergency room.

HEAT STROKE

This condition can prove to be fatal, so immediate medical attention is necessary. It is caused by a complete breakdown of the body's heat regulating system, with heat production exceeding heat loss. Common symptoms include hot, dry skin, little or no sweating, severe headache, visual disturbance, rapid temperature rise, loss of consciousness, flushed face, weakness and confusion.

First aid treatment should be aimed at cooling the body quickly and getting the victim to the hospital. Remove the person from the source of heat, loosen the clothing, and try to cool the body as rapidly as possible, using a cool bath or cold compresses. Don't give water to a heat stroke victim.

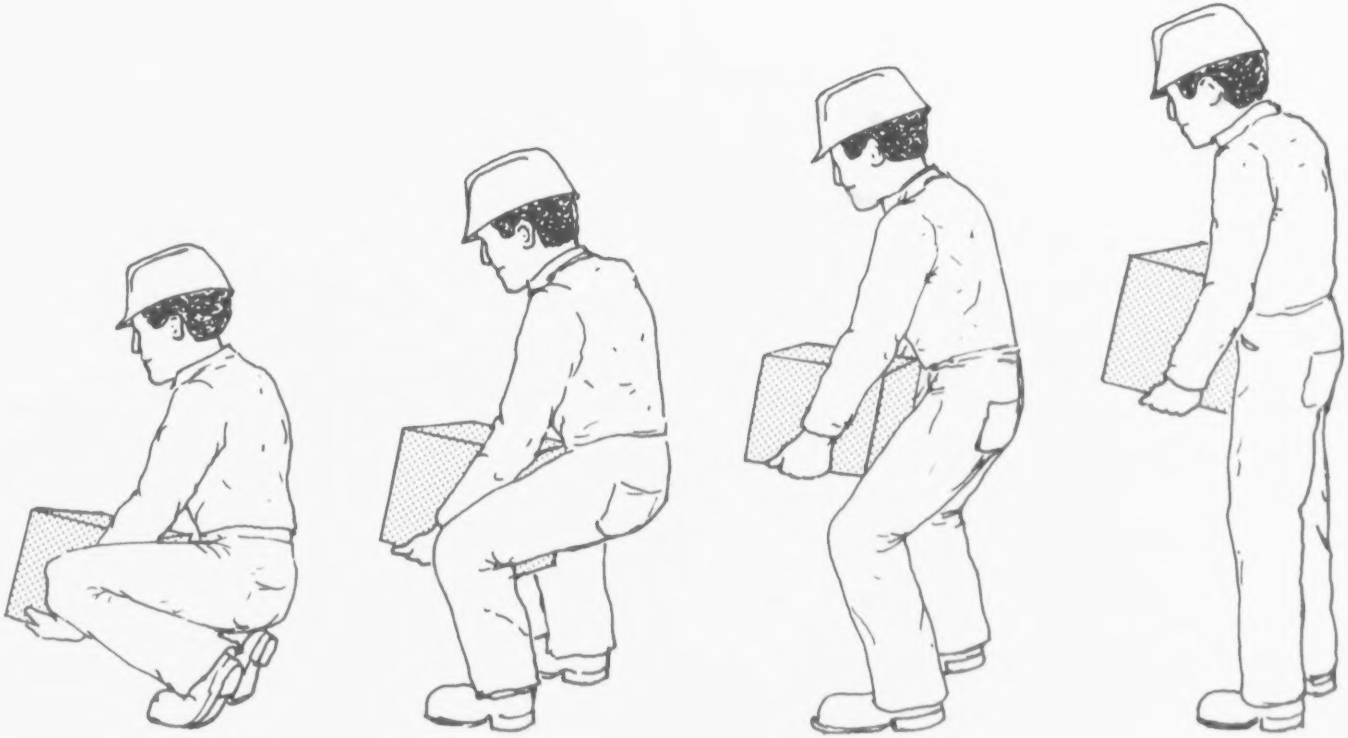
So when the temperatures begin to soar upward, take a few precautions to minimize your body's level of heat stress:

- Try to take frequent rest periods.
- Space heavier workloads or workouts throughout the day, rather than concentrating them in a few consecutive hours.
- Avoid heavy activity during the hottest part of the day.
- Drink plenty of water or other fluids.
- Wear loose, light clothing that reflects the sun's rays and allows sweat to evaporate. A hat will add further protection.

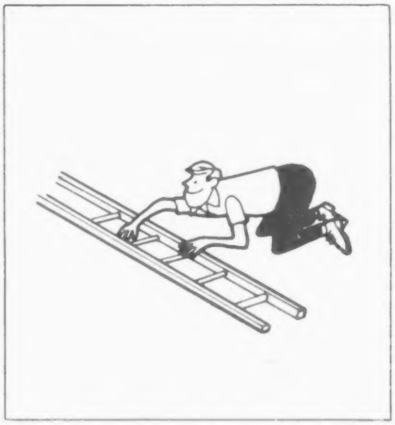
Coping with summer heat is just a matter of using common sense.

Used with permission of the National Safety Council, from *Safe Worker*.

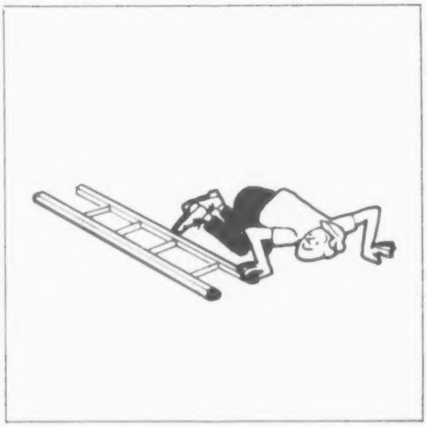
Correct Way to Lift Heavy Objects



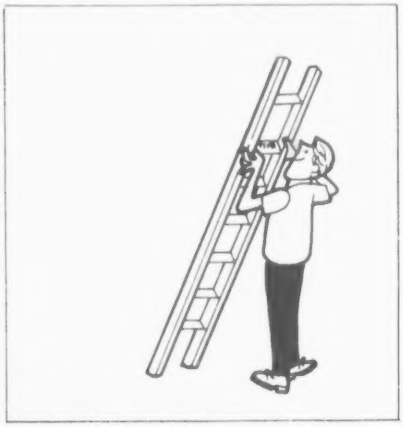
Ladder Safety



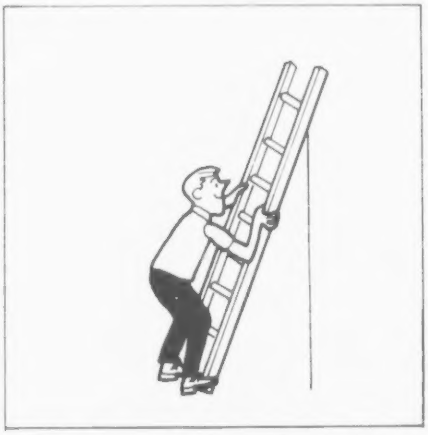
Check Condition



Check Safety Shoes



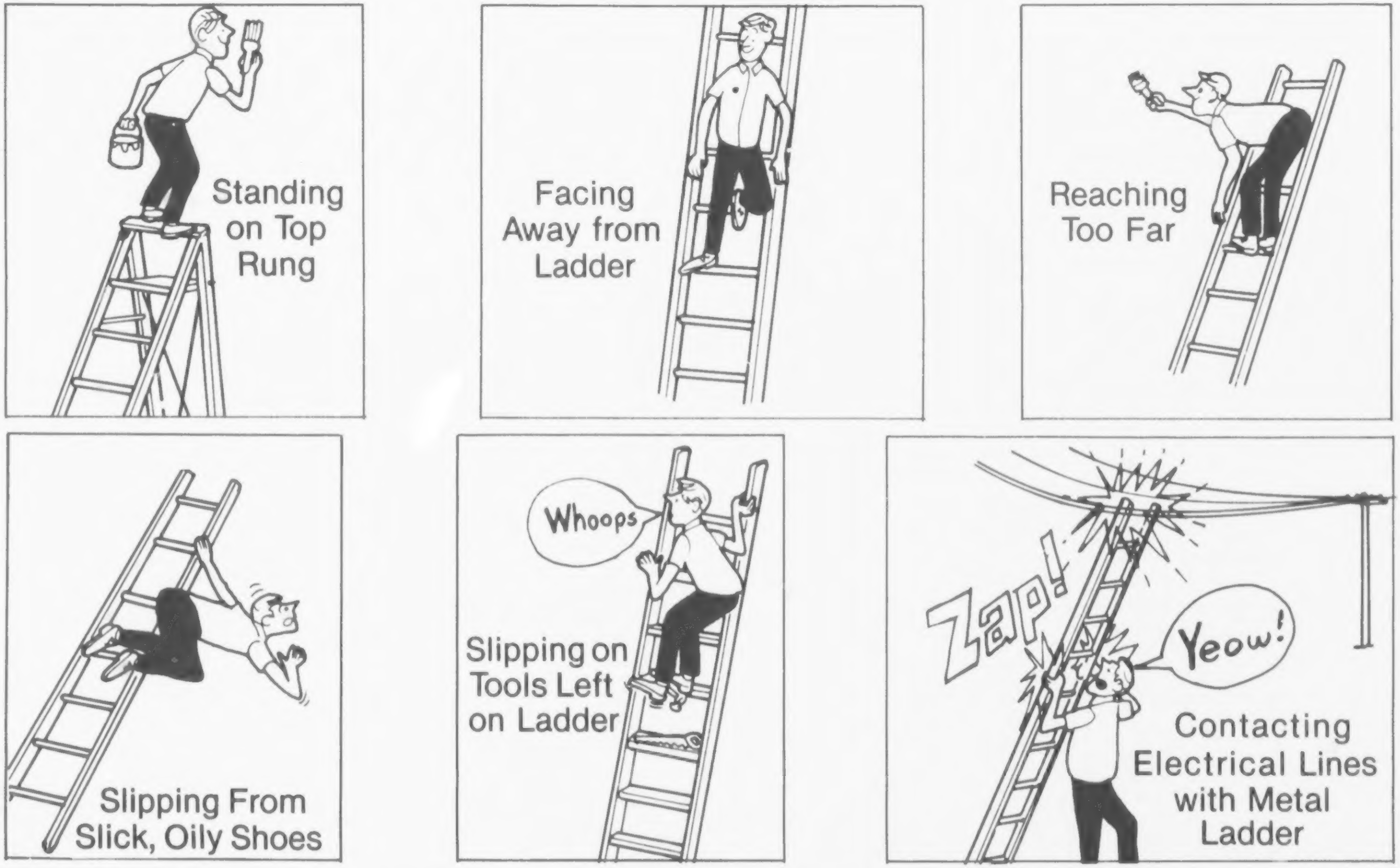
Check Load Limit



Place at Comfortable Stance

Adapted with permission of American Association for Vocational Instructional Materials, Athens, Georgia, from *Developing Shop Safety Skills* by Clinton O. Jacobs and J. Howard Turner, 1981.

Ladder Danger

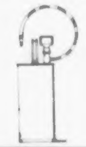
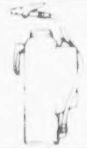
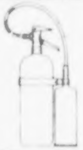
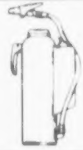
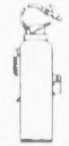
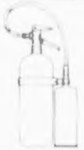
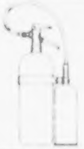
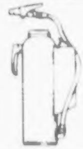
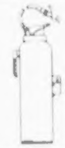
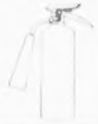

Standing on Top Rung
Facing Away from Ladder
Reaching Too Far
Slipping From Slick, Oily Shoes
Whoops
Slipping on Tools Left on Ladder
Zap!
Yeow!
Contacting Electrical Lines with Metal Ladder

Adapted with permission of American Association for Vocational Instructional Materials, Athens, Georgia, from *Developing Shop Safety Skills* by Clinton O. Jacobs and J. Howard Turner, 1981.

TM #3

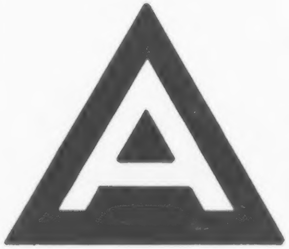
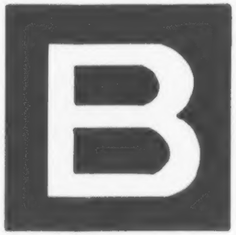
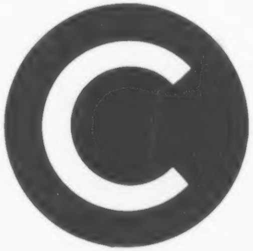
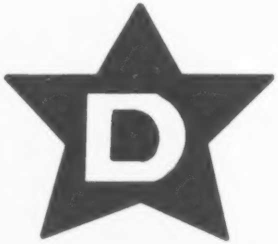
FCCM - 209-A

Types of Fire Extinguishers

KIND OF FIRE		APPROVED TYPE OF EXTINGUISHER					
		MATCH UP PROPER EXTINGUISHER WITH CLASS OF FIRE SHOWN AT LEFT Important: Using the wrong type extinguisher for the fire may be dangerous					
DECIDE THE CLASS OF FIRE YOU ARE FIGHTING. . .	**THEN CHECK THE COLUMNS TO THE RIGHT OF THAT CLASS**	**CARBON DIOXIDE** Carbon Dioxide Gas Under Pressure	**PUMP TANK** Plain Water	**MULTI-PURPOSE DRY CHEMICAL**	**ORDINARY DRY CHEMICAL**	**HALON**	**DRY POWDER**
A **CLASS A FIRES** Use These Extinguishers ORDINARY COMBUSTIBLES ●Wood ●Paper ●Cloth, etc.							
B **CLASS B FIRES** Use These Extinguishers FLAMMABLE LIQUIDS, GREASE ●Gasoline ●Paints ●Oils, etc.							
C **CLASS C FIRES** Use These Extinguishers ELECTRICAL EQUIPMENT ●Motors ●Switches, etc.							
D **CLASS D FIRES** Use This Extinguisher COMBUSTIBLE METALS ●Iron ●Magnesium							

Adapted with permission of American Association for Vocational Instructional Materials, Athens, Georgia, from *Developing Shop Safety Skills* by Clinton O. Jacobs and J. Howard Turner, 1981.

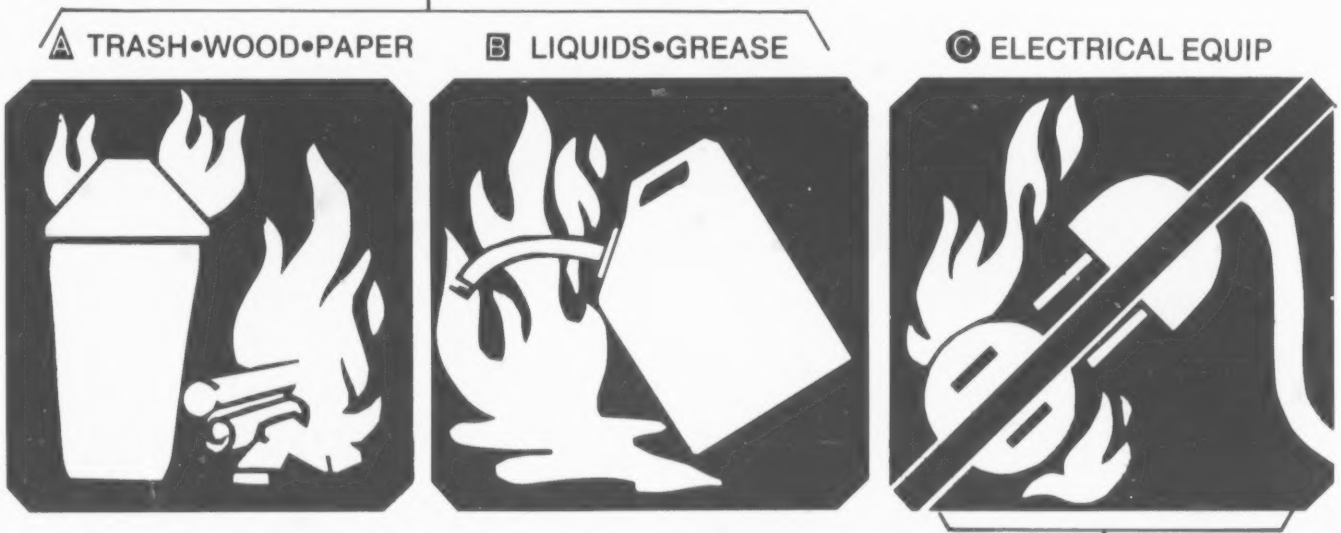
Standard Letter Symbols for Fire Extinguishers

GREEN	RED	BLUE	YELLOW
			
ORDINARY COMBUSTIBLES	FLAMMABLE LIQUIDS	ELECTRICAL EQUIPMENT	COMBUSTIBLE METALS

Distinctive letters, shapes, and colors mark extinguishers according to the classes of fires on which they should be used.

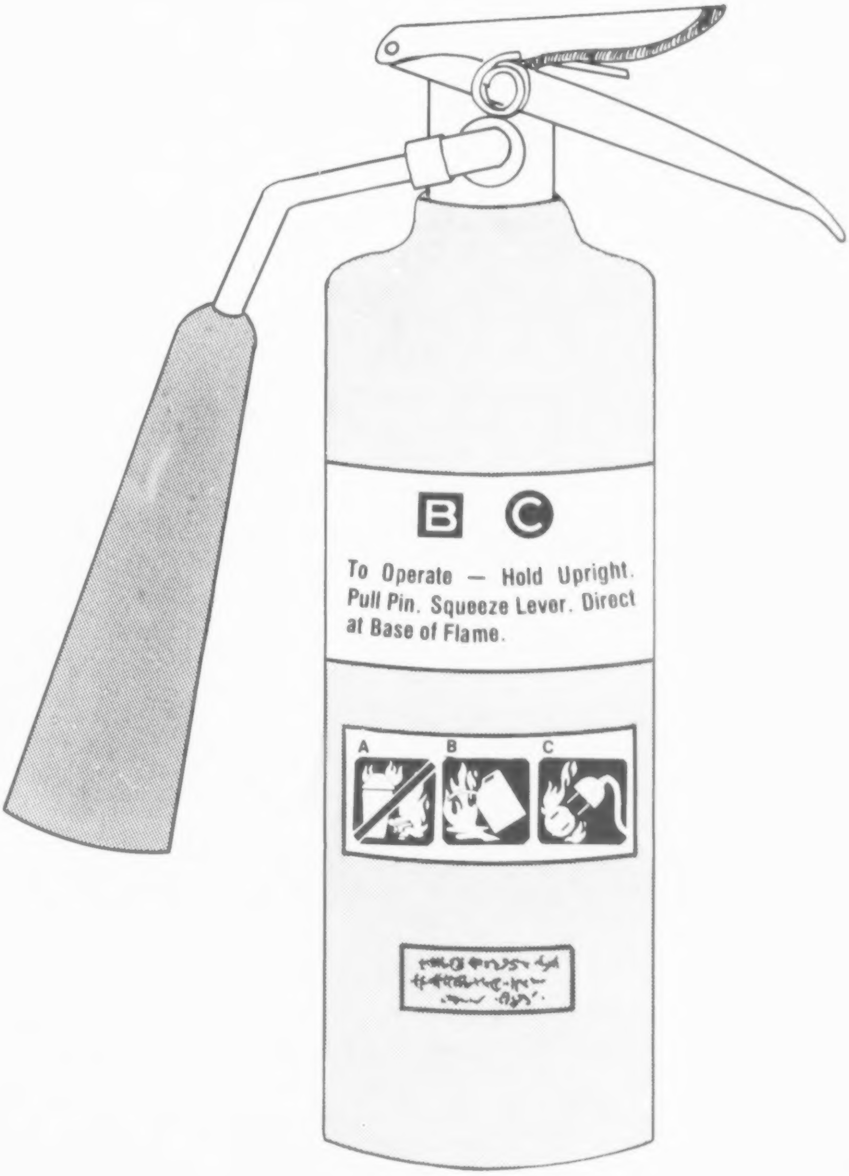
New Pictorial Symbols Used to Label Fire Extinguishers

Symbols with blue backgrounds indicate fire extinguisher can be used for class of fire portrayed.

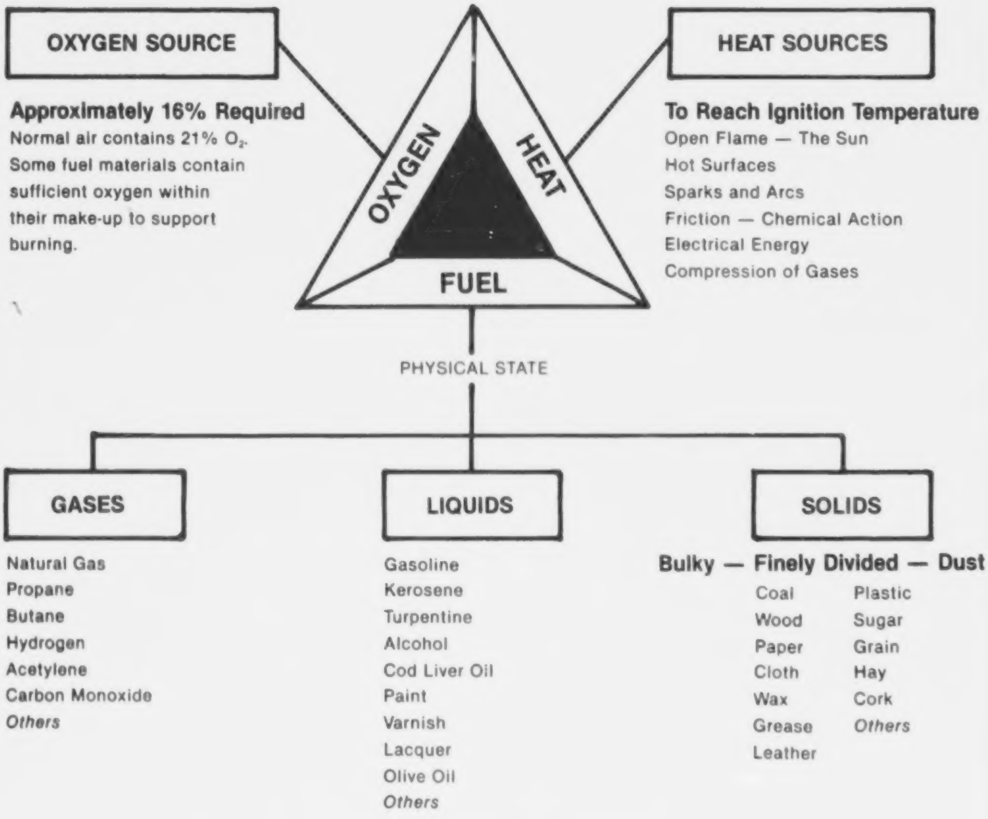

A TRASH•WOOD•PAPER
B LIQUIDS•GREASE
C ELECTRICAL EQUIP

Symbols with red line across a black background indicate fire extinguisher *cannot* be used for class of fire portrayed.

Fire Extinguisher Suitable for Class B and Class C Fires


B C
To Operate — Hold Upright. Pull Pin. Squeeze Lever. Direct at Base of Flame.
A
B
C

Fire Triangle



OXYGEN SOURCE

Approximately 16% Required
Normal air contains 21% O_2.
Some fuel materials contain sufficient oxygen within their make-up to support burning.

HEAT SOURCES

To Reach Ignition Temperature
Open Flame — The Sun
Hot Surfaces
Sparks and Arcs
Friction — Chemical Action
Electrical Energy
Compression of Gases

GASES

- Natural Gas
- Propane
- Butane
- Hydrogen
- Acetylene
- Carbon Monoxide
- *Others*

LIQUIDS

- Gasoline
- Kerosene
- Turpentine
- Alcohol
- Cod Liver Oil
- Paint
- Varnish
- Lacquer
- Olive Oil
- *Others*

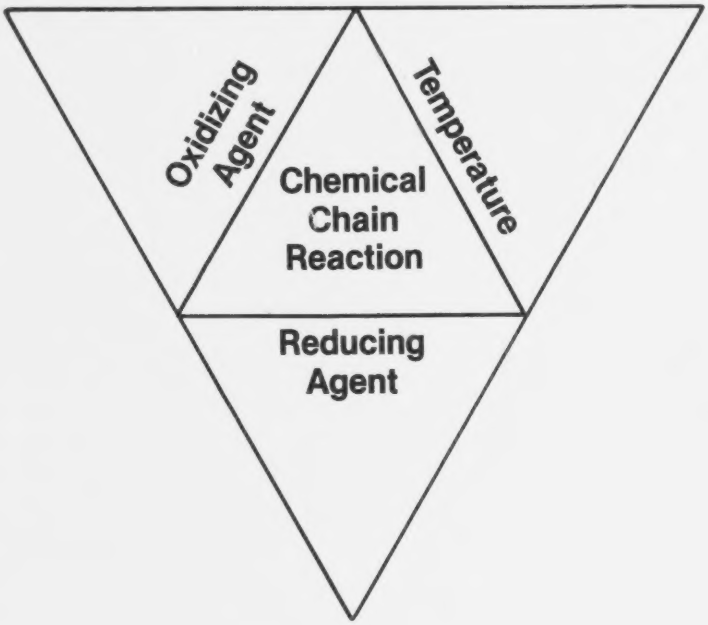
SOLIDS

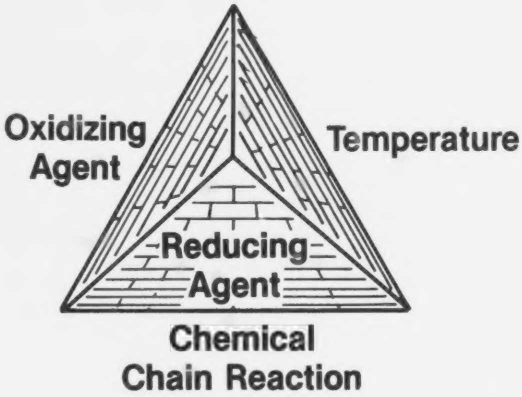
Bulky — Finely Divided — Dust

- Coal
- Wood
- Paper
- Cloth
- Wax
- Grease
- Leather
- Plastic
- Sugar
- Grain
- Hay
- Cork
- *Others*

Used with permission of the Board of Regents, Oklahoma State University, Stillwater, Oklahoma, from *Essentials of Fire Fighting*, 2nd edition, Gene P. Carlson and William J. Vandevort, eds., 1983.

Fire Tetrahedron

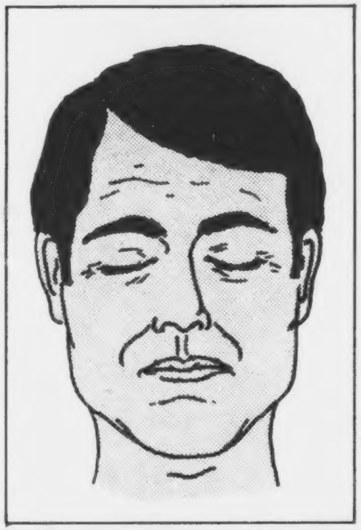

Oxidizing Agent
Temperature
Chemical Chain Reaction
Reducing Agent


Oxidizing Agent
Temperature
Reducing Agent
Chemical Chain Reaction

Adapted with permission of the Board of Regents, Oklahoma State University, Stillwater, Oklahoma, from *Essentials of Fire Fighting*, 2nd edition, Gene P. Carlson and William J. Vandevort, eds., 1983.

Face and Skin Conditions in Heat Stroke and Heat Exhaustion

Heat Stroke

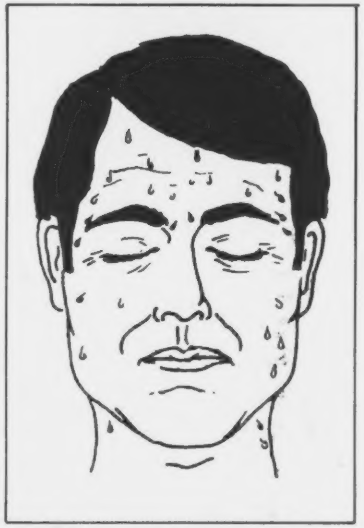


Skin Condition

Hot Red Dry

Cool body quickly.
Get immediate medical help.

Heat Exhaustion



Skin Condition

Clammy Pale Heavy Sweating

Get victim out of sun and heat, elevate feet, cool body, give sips of salt water.

SAFETY AND BASIC FIRST AID
UNIT V

INFORMATION SHEET

I. Terms and definitions associated with safety

A. Safety — Freedom from danger, risk, or injury

B. OSHA — Occupational Safety and Health Act; federal legislation designed to ensure safe and sanitary working conditions for employees

C. NIOSH — National Institute for Occupational Safety and Health

D. MSHA — Mine Safety and Health Administration

E. Accident — Any suddenly occurring, unintentional event that causes injury or property damage

F. Hazard — Source of danger

G. Carelessness — Failure to think before one acts; failure to pay attention

H. Flammable — Capable of being easily ignited; burning with extreme rapidity

I. Explosive — Tending to blow up or burst violently and loudly

J. Combustible — Capable of bursting into flames

K. Extinguish — To put out a fire; to cause to cease burning

L. Pressurized — Stored under pressure greater than the pressure of the atmosphere

II. Reasons why you must be safety conscious on the job

A. You have a responsibility to yourself to think before you act and to stay alert and aware of where you are in order to prevent personal injury

B. You have a responsibility to your family members to continue providing for them and to keep them safe

C. You have a responsibility to your fellow workers to prevent accidents to them by being concerned with their safety and welfare and by encouraging them to be safety conscious

D. You have a responsibility to your employers to prevent accidents so that they are not shorthanded, their job progress is not slowed down or stopped, and their insurance rates are not increased, making them less competitive

INFORMATION SHEET

III. Consequences of a worker's using alcohol or drugs on the job

   A. Causes worker to be tardy or absent

   B. Causes worker to neglect duty and be less productive

   C. May cause worker to lose job

   D. Creates a safety hazard to worker and to fellow workers

   E. Drives up cost of production and cost of insurance, making employer less competitive

IV. Job-safety rules

   A. **General safety**

      1. Be familiar with location of fire-fighting and first-aid equipment

      2. Be alert and conduct yourself in a manner that will ensure safe practices

      3. Be conscious of others' safety and encourage others to do the same

      4. Report all accidents, regardless of nature or severity, to the supervisor

      5. Be aware of OSHA, NIOSH, MSHA, and job-project safety rules

      6. Be certain ample ventilation is provided in areas where carbon monoxide may be present

   B. **Personal safety**

      1. Remove rings and other jewelry when working

      2. Confine long hair before operating power equipment

      3. Wear close-fitting clothing appropriate for activity being performed

      4. Wear safety shoes, proper boots, and gloves

         (NOTE: All protective and safety equipment must be OSHA-approved.)

      5. Wear face and eye protection as required

         EXAMPLES: Safety glasses, goggles, face shields

      6. Wear ear protection as required

         EXAMPLES: Earplugs, earmuffs

7. Wear respiratory protection approved for the contaminant you will be exposed to

   EXAMPLE: Dust respirator

   (NOTE: On jobs where it will be necessary for workers to wear respirators, respirator cleaning and storage facilities must be provided, medical examinations must be given to workers using the respirators, and a formal program should be established to train workers in selecting the correct respirator, in making sure that the respirator fits properly, and in proper procedures for using and maintaining the respirator.)

8. Protect exposed skin

   EXAMPLES: Use skin cream, body lotion, or petroleum jelly.

9. *Never* use compressed air to clean clothes or person

10. *Do not* carry sharp tools in your pockets

11. Encourage and enforce personal hygiene

    EXAMPLES: Bathe and change your clothes on a regular basis; change your gloves often (especially if they are wet); change your shoes if they get wet; clean the band inside your hard hat; remove clothing as soon as possible if it is soaked with gasoline or solvents.

C. **Equipment and tool safety**

1. Obey all safety rules, and observe limitations on equipment according to specifications and manufacturer's requirements

2. Maintain all tools in a safe working order, and properly store tools when not in use

3. Retain guards and safety devices on all equipment

4. Tag and report to the supervisor any defective tools, machines, or other equipment

5. Be sure to shut off all power equipment when finished with it, and *do not* leave equipment until it has stopped completely

6. Operate equipment only after receiving instructions on how to operate it safely

7. Disconnect power from equipment before changing accessories and before performing service or maintenance on it

8. Use the correct tool for the job for which it was intended

INFORMATION SHEET

9. Clean chips from grinders and other equipment with a brush; *do not* clean equipment with your hands or with a rag; *do not* clean equipment while it is running

D. **Work-area safety**

1. Arrange equipment to permit safe, efficient work practices and ease of cleaning
2. Store materials and supplies safely in their proper places
3. Store tools and accessories safely in cabinets, on racks, or in suitable storage areas
4. Keep work area clear of debris and other hazards
5. Always remove nails from wood prior to storage or disposal
6. Clean floors of obstructions and slippery substances; clean up spills immediately
7. Keep aisles, exits, and traffic areas free of materials and debris
8. Dispose of combustible materials properly
9. Keep sufficient brooms, brushes, waste containers, and other housekeeping equipment readily available

E. **Flammable-liquid safety**

1. Carefully read labels on all flammable liquids, and use flammable liquids only in open, well-ventilated areas

   (NOTE: Be cautious to prevent inhaling or igniting fumes from flammable liquids.)

2. Be sure that all flammable liquids are marked correctly for storage
3. Store all flammable liquids properly and only in approved safety containers

   (NOTE: Oily rags and flammable materials should be stored in metal containers with self-sealing lids.)

4. When clothing is soaked by a flammable liquid, immediately change clothing and cleanse body with appropriate cleaner
5. Use flammable liquids only for their intended purposes

   EXAMPLE: *Never* use gasoline as a cleaner.

INFORMATION SHEET

6. *Do not* use flammable liquids near fire or flame
7. Always be aware of location of appropriate fire extinguisher
8. Stop, drop, and roll to smother fire; *never* run

F. **Gasoline-powered-equipment safety**

1. Use caution to prevent contact with hot manifolds and hoses
2. Be sure that equipment is out of gear before starting
3. Always keep appropriate fire extinguisher near when starting and operating gasoline-powered equipment
4. *Do not* pour gasoline into carburetor or cylinder head when starting engine; use recommended starting fluid
5. *Never* pour gasoline into fuel tank when engine is hot or when engine is running
6. *Do not* operate equipment that is leaking gasoline
7. Stop, drop, and roll to smother fire; *never* run

G. **Materials-handling safety** (cement, concrete, organic solvents)

1. Avoid contact with the skin
2. Protect skin that is exposed

   EXAMPLES: Use protective skin cream, body lotion, or mild ointments.

3. Wear protective clothing

   EXAMPLES: Wear close-fitting clothing with snug wristbands, ankle bands, and neckband.

4. Wear properly maintained, OSHA-approved safety equipment

   EXAMPLES: Respirator, goggles, face shield, hard hat, safety belt, safety harness

5. Use good work practices to reduce dust in the air when handling cement and concrete

   EXAMPLES: *Do not* shake out cement bags unnecessarily; stand upwind when dumping cement bags; wet concrete before cutting or grinding; *do not* use compressed air to blow cement dust off clothing or work surface.

INFORMATION SHEET

        6. Be certain adequate ventilation is provided when using epoxy resins, organic solvents, and other toxic substances

        7. *Never* use solvents to clean skin

        8. Immediately remove epoxy, organic solvents, and other substances from skin; use appropriate cleansing agents to remove these substances

V. Safety precautions pertaining to scaffolds

    A. Maintain OSHA regulations

    B. Use only approved scaffolding

    C. Inspect scaffolds regularly

    D. Install all braces and accessories according to manufacturer's recommendations

    E. Install anchors and guy wires on freestanding scaffolds as required

    F. Keep scaffolds plumb and level

    G. *Do not* overload scaffolds

    H. Be sure all safety rails are installed according to OSHA regulations

    I. Be sure wheels are locked before ascending rolling scaffolds

    J. Always check for electrical wires and disengage wires before erecting metal scaffolds in the vicinity

    K. *Do not* work on scaffolds during storms or high winds, or when scaffolds are covered with ice or snow

VI. Safety precautions pertaining to ladders

    A. Fully spread and lock stepladders before using

    B. *Do not* use ladders that are *not* equipped with safety shoes

    C. *Never* overreach from a ladder

    D. *Never* work from the top step of a ladder

    E. *Never* use ladders in horizontal position

    F. *Do not* climb a ladder that is occupied by someone else

    G. *Never* use a metal ladder when there is any possibility of contact with electrical wires or conductors

INFORMATION SHEET

H. Place ladders with approximately one-quarter of their support length away from vertical plane of top support, and extend ladders at least 3 feet above top support (Figures 1 and 2)

EXAMPLES:

FIGURE 1

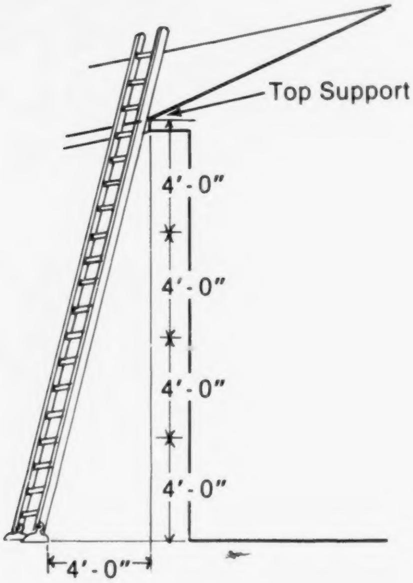
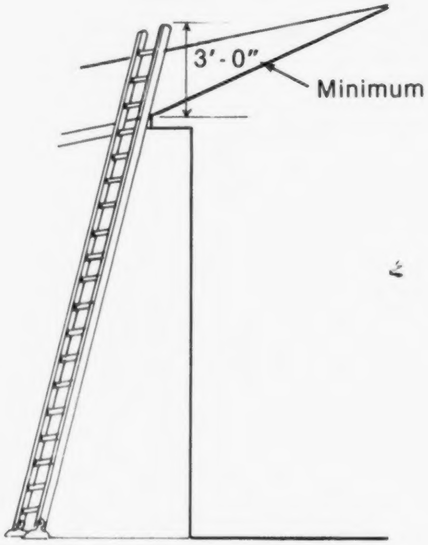


FIGURE 2



I. Secure ladders at both top and bottom to prevent displacement; brace long ladders at intermediate points to prevent spring

J. Remove ladder when you are finished using it, and always remove and store ladder at end of workday

VII. Colors and applications of the safety color code

A. Federal safety red

1. Designates danger
2. Identifies fire-protection equipment and its location
3. Identifies portable containers of flammable liquids
4. Identifies emergency stop bars, stop buttons, and emergency electrical stop switches on machinery

INFORMATION SHEET

B. Federal safety yellow

1. Designates caution and marks physical hazards

   EXAMPLES: Low beams, protruding extensions, steps

2. Designates waste containers for explosive or combustible materials

3. Designates caution against starting, using, or moving equipment while it is under repair, and against the use of defective equipment

4. Identifies the starting point or power source of machinery

C. Federal safety orange

1. Designates dangerous parts of equipment that may cut, crush, shock, or otherwise injure

2. Designates safety starter buttons and parts of equipment that may cause electrical shock

3. Designates exposed parts (edges only) of pulleys, gears, rollers, cutting devices, and power saws

D. Federal safety purple (or black or magenta on safety yellow) — Designates radiation hazards

E. Federal safety blue

1. Designates caution against and provides information about machines or equipment out of order or under repair

2. Identifies out-of-order signs on equipment

F. Federal safety green

1. Designates location of safety equipment other than fire-fighting equipment

2. Designates location of first-aid equipment

G. Federal safety black and white (used individually or in combination)

1. Designates traffic flow

2. Designates items for housekeeping purposes

3. Designates storage areas

VIII. Descriptions of classes of fires

(NOTE: Fire extinguishers are labeled according to the class or classes of fires on which they may be used, the class letters prominently displayed in distinctive shapes and colors. Most new extinguishers also contain pictorial labels depicting the class or classes of fires on which the extinguisher may or may not be used.)

INFORMATION SHEET

A. Class A — Fires that occur in ordinary combustible materials such as wood, rags, rubber, and plastics

B. Class B — Fires that occur with flammable liquids such as gasoline, oil, grease, paint, and thinners

C. Class C — Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring

D. Class D — Fires that occur with combustible metals such as iron, magnesium, sodium, and potassium

IX. Terms and definitions associated with toxic substances

A. Toxic — Having the nature of a poison

B. Absorb — To suck up or take up (as a sponge)

C. Solvent — Liquid that dissolves or is capable of dissolving one or more other substances

D. Vapor — Diffused matter suspended in the air in a gaseous state as distinguished from the liquid or solid state

E. Irritate — To cause itching, burning, and/or reddening

F. Contaminate — To make impure or unclean; to bring into contact with dirt or other impurity from an outside source

G. Fume — Smoke, vapor, or gas; the suspension of microscopic particles in gas; engine exhaust

H. Mist — Moisture in the form of particles floating or falling in the air

X. Toxic substances a concrete mason may contact on the job

(NOTE: Although the following list may seem extensive, the items listed are only some of the toxic substances that a concrete mason is most likely to contact. There are thousands of toxic substances, and contact with any of these substances may result in cancer, liver disease, kidney disease, nerve damage, brain damage, paralysis, damage to the reproductive system, and possibly death.)

A. Asbestos

B. Acetone

C. Arsenic

D. Benzene

E. Cadmium

F. Chromates

G. Cobalt

H. Coal dust

I. Coal-tar pitch

J. Chlorine

K. Carbon tetrachloride

L. Carbon monoxide

INFORMATION SHEET

M. DDT

N. Epoxies

O. Fiberglass

P. Hydrochloric acid

Q. Lead compounds

R. Nickel compounds

S. Ozone

T. Petroleum oils

U. Plastic film and polyurethane foam

(NOTE: When the above two items burn, they give off a deadly gas; however, they are safe in their unsual solid form.)

V. Sulfuric acid

XI. Forms of toxic substances

A. Solids

EXAMPLES: Asbestos, concrete, fiberglass

B. Liquids

EXAMPLES: Acetone, chlorine, epoxies

C. Vapors, mists, fumes, and gases

EXAMPLES: Carbon monoxide, ozone, smoke

XII. Ways toxic substances enter the body

A. Inhaled

EXAMPLES: Toxic substances such as carbon monoxide, airborne pesticides, and dusts may be inhaled directly from the air when you are breathing. Smokers may also inhale gases, dust, fumes, and mists when smoking or when smoking cigarettes, pipes, or cigars contaminated by direct contact with toxic substances.

B. Absorbed through the skin

EXAMPLES: Some lead compounds, pesticides, and solvents can be absorbed directly through the skin.

C. Ingested while eating and drinking

EXAMPLES: Food and drink may be contaminated from contact with toxic substances on the hands or from dust, fumes, and mists that settle on them from the air.

D. Contracted through open cuts and sores

EXAMPLES: Open cuts and sores come in direct contact with toxic substances when they are touched by contaminated hands or when dust, fumes, and mists settle on them from the air.

INFORMATION SHEET

XIII. Definitions of ways toxic substances affect the body

(NOTE: Some toxic substances have both local and systemic effects. Tuluene solvent, for example, causes a local irritation to the eyes and respiratory tract, but it can also spread to affect the nervous system and the liver.)

A. Local effect — Substance comes in direct contact with an area of the body and affects only that area

EXAMPLE: An irritating gas causes burning of the eyes, nose, throat, and lungs when it is inhaled.

B. Systemic effect — Substance is absorbed by one area of the body but spreads throughout the body and may affect other body systems

EXAMPLE: When inhaled, a solvent vapor eventually causes a headache and a drunken feeling.

XIV. Consequences of exposure to toxic substances

(NOTE: Some toxic substances may seem to cause little bodily damage after exposure; however, without proper care, severe damage or death may be the result.)

A. Mild irritation

EXAMPLES: Skin rashes, headache, burning eyes, sneezing, coughing

B. Severe damage to any or all of the body's systems

EXAMPLES: Shortness of breath, genetic abnormalities, coma, shock, hemorrhage, allergies

C. Terminal conditions or diseases

EXAMPLES: Cancer, black lung, suffocation, emphysema

XV. Terms and definitions associated with first aid

A. First aid — Immediate, temporary care given to the victim of an accident or sudden illness until the services of a physician can be obtained

B. Resuscitation — Act of reviving a person by bringing the person back to full consciousness

C. Traumatic shock — Depressed condition of many of the body functions due to failure of enough blood to circulate through the body

D. Tourniquet — Any device, such as a bandage and stick, used to compress a blood vessel to stop bleeding or to control blood flow

(NOTE: Tourniquets are used only on severe, life-threatening hemorrhage that cannot be controlled by any other means.)

INFORMATION SHEET

- E. Hemorrhage — Heavy loss of blood
- F. Closed fracture — Broken bone beneath the skin with no open wound
- G. Open fracture — Broken bone associated with an open wound

  EXAMPLES: A broken bone tears through the skin; machinery penetrates the skin and breaks one or more bones.

XVI. Reasons why knowledge of first aid is important

- A. May mean the difference between life and death
- B. May mean the difference between temporary and permanent disability
- C. May mean the difference between rapid recovery and long hospitalization
- D. Prepares one for what to do and what *not* to do in an emergency
- E. Promotes safety awareness

XVII. Concrete masonry job-related injuries that may require first aid

- A. Frostbite
- B. Bleeding

  EXAMPLES: Bleeding caused by cuts, punctures, scrapes, severed fingers or limbs

- C. Burns

  EXAMPLES: Burns caused by coming in contact with hot engines, fire, or electrical or welding equipment; chemical burns; sunburn

- D. Loss of consciousness

  EXAMPLES: Blow to the head, being overcome by fumes, heat-related distress

- E. Respiratory failure/cardiac arrest

  EXAMPLES: Obstruction of the air passage, inhalation of toxic gases, explosion, electrocution, circulatory collapse (shock), heart attack, compression of the chest caused by a heavy beam or a piece of equipment falling on victim

- F. Eye injury

  EXAMPLES: Foreign objects or substances in eye; welding burn; cuts; punctures; irritation from toxic fumes or gases

INFORMATION SHEET

G. Muscle and ligament strain or sprain

EXAMPLES: Improper lifting, falls

H. Broken bones

(NOTE: Injuries to the skeletal system are common in all types of on-the-job accidents.)

EXAMPLES: Falling from a scaffold, being hit by moving equipment, being hit by falling objects

I. Poisoning

EXAMPLES: Breathing exhaust from a heater in a closed area, cement poisoning from wearing wet gloves too long, breathing toxic dust from asbestos removal, working with epoxy compounds without respirator and adequate ventilation

XVIII. First-aid actions to follow in an emergency

(NOTE: When you give first aid, you must first deal with the victim's physical condition, the victim's emotional state, and the whole accident situation. However, first aid may also include care needed later if medical help is delayed or is not available. Urgent care is first aid given in a life-threatening situation. These situations include stopped breathing, heart attack, stroke, heavy bleeding, poisoning, and shock. The actions listed below are from the Red Cross book *Standard First Aid and Personal Safety* and are given in the order you might follow in an emergency.)

A. Rescue victim and yourself

B. Restore or maintain breathing and heartbeat

C. Control heavy bleeding

D. Treat for poisoning

E. Prevent traumatic shock

F. Examine victim carefully

G. Seek medical help

H. Keep checking and assisting victim until medical help is obtained

XIX. Symptoms of traumatic shock

(NOTE: Traumatic shock can occur to some degree with any injury. It can threaten life even though the victim's injuries may not otherwise be fatal. The three objectives in treating shock are [1] to improve circulation of the blood, [2] to ensure an adequate supply of oxygen, and [3] to maintain normal body temperature.)

INFORMATION SHEET

A. Early stages

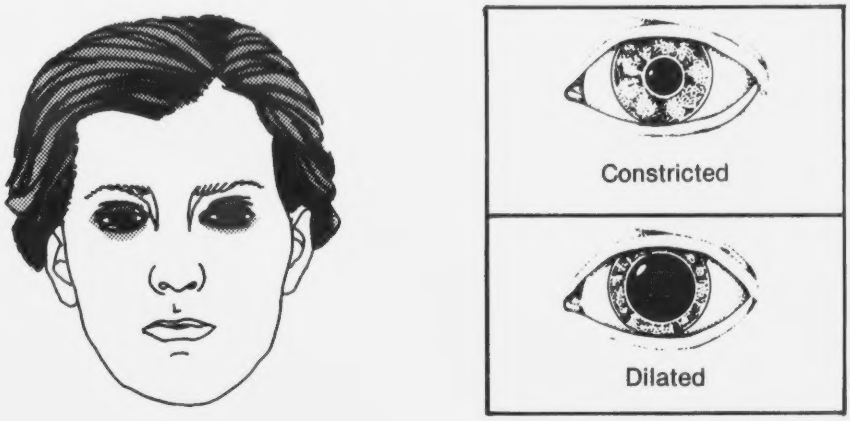
1. Pale or bluish skin that is cold to the touch
2. Moist, clammy skin if perspiration has occurred
3. Weakness
4. Rapid pulse (over 100 beats per minute), often too faint to be felt in wrist but perceptible in carotid artery at side of neck or femoral artery at groin
5. Increased rate of breathing that may be either shallow or deep and irregular
6. Restlessness, anxiousness, severe thirst if victim is in shock from hemorrhage
7. Vomiting or nausea

B. Late stages

1. Apathy and relative lack of responsiveness
2. Sunken eyes with vacant expression and widely dilated pupils (Figure 3)

   EXAMPLE:

FIGURE 3



3. Mottled appearance of skin, indicating that victim's blood pressure has fallen to a very low level
4. Loss of consciousness, low body temperature, and death if untreated

INFORMATION SHEET

XX. Measures to take for prevention of heat stroke, heat cramps, and heat exhaustion

A. Drink plenty of fluids

B. *Do not* overexert

C. Wear lightweight clothing that allows sweat to evaporate

D. Keep head covered and face shaded

E. Take frequent short work breaks

F. Rest in the shade or in an air-conditioned room whenever possible

XXI. Symptoms of heat stroke and heat exhaustion

A. Heat stroke — Flushed, hot, dry skin and high body temperature

(NOTE: Heat stroke is an immediate, life-threatening emergency urgently requiring medical attention. The main symptoms of heat stroke are listed above, but other symptoms may include dizziness, nausea, headache, rapid pulse, offensive body odor, and unconsciousness.)

B. Heat exhaustion — Pale, cool, clammy skin and normal body temperature

(NOTE: Heat exhaustion is a much less dangerous condition than heat stroke. Symptoms, in addition to the main ones listed above, may include heavy sweating, extreme tiredness or weakness, headache, vomiting, and fainting. Heat cramps in the abdomen or legs may accompany or precede heat exhaustion.)

XXII. Measures to take for prevention of frostbite

(NOTE: Work should be designed to minimize exposure to cold.)

A. Wear protective cold-weather clothing

B. Wear several layers of light clothing rather than one layer of heavy clothing

C. Take break periods in a warm place

D. Drink warm beverages

E. Try to keep from sweating

F. *Do not* get clothes wet

(NOTE: Change clothes as soon as possible if they do get wet.)

XXIII. Symptoms of frostbite

A. Skin will turn white or grayish

B. Skin surface will be hard, but underlying tissue will be soft

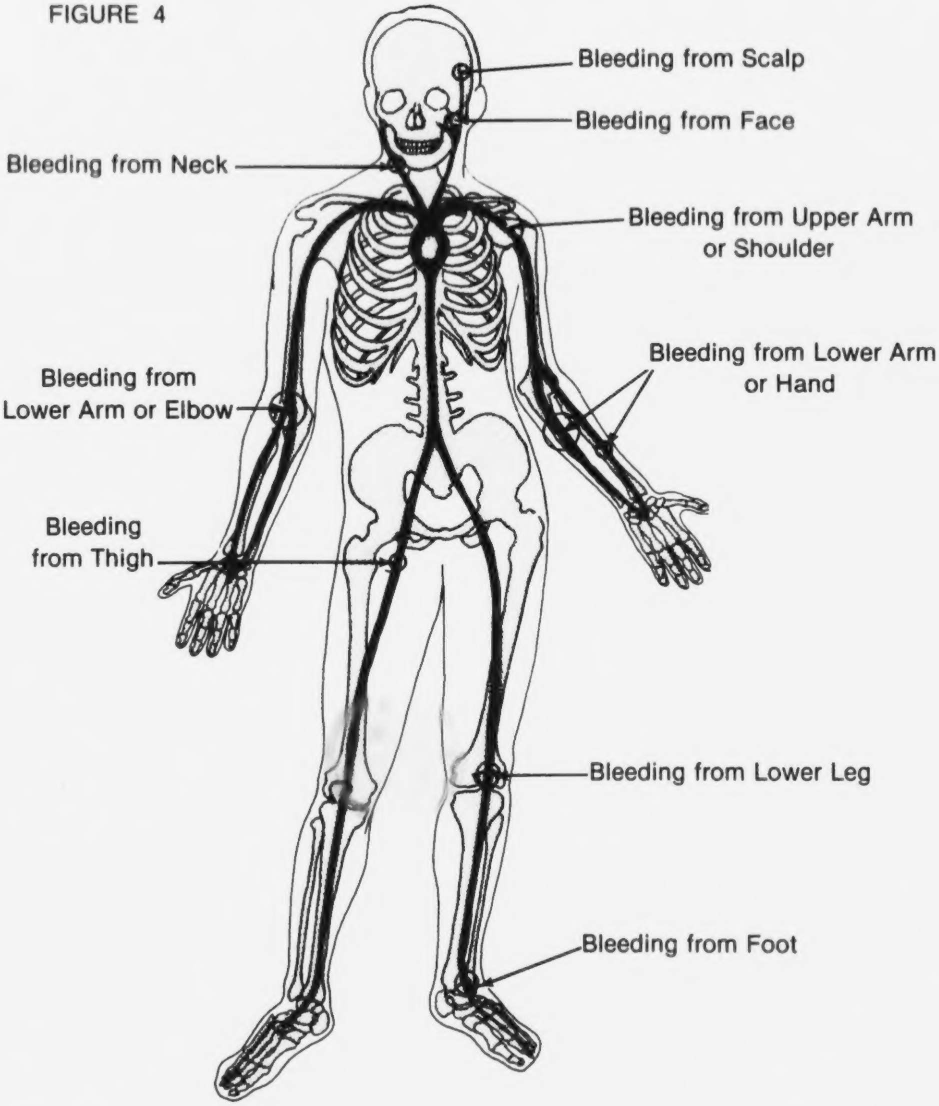
INFORMATION SHEET

C. With deeper involvement, large blisters will appear on skin surface as well as on underlying tissue, and affected area is hard, cold, and insensitive (numb)

XXIV. Pressure points to use to control bleeding from various areas of the body (Figure 4)

(NOTE: Because direct pressure stops circulation only at the wound, it is better to control bleeding through the use of direct pressure than to use a pressure point or a tourniquet. *Do not* use fingertips to apply pressure. *Do not* use a pressure point for an arm or leg wound unless direct pressure and elevation do not stop the bleeding. Always release the pressure point gradually when bleeding has been brought under control.)

FIGURE 4


Bleeding from Scalp
Bleeding from Face
Bleeding from Neck
Bleeding from Upper Arm or Shoulder
Bleeding from Lower Arm or Hand
Bleeding from Lower Arm or Elbow
Bleeding from Thigh
Bleeding from Lower Leg
Bleeding from Foot

INFORMATION SHEET

XXV. Symptoms of first-, second-, and third-degree burns

A. First-degree burns

(NOTE: First-degree burns can be caused by sunburn, light contact with hot objects, accidentally touching a hot engine component, or contact with hot water or scalding steam from a radiator.)

1. Redness or discoloration
2. Mild swelling and pain
3. Rapid healing

B. Second-degree burns

(NOTE: Second-degree burns can be caused by contact with hot liquids [hot tar or asphalt], mild electrical burns, or by a deep sunburn.)

1. Pain greater than that caused by first-degree burn
2. Damage extending into first layer of tissue
3. Mottled or red areas
4. Blistering
5. Considerable swelling
6. Wet appearance of burned area due to loss of plasma

C. Third-degree burns

(NOTE: Third-degree burns can be caused by contact with flames, contact with hot objects, acid, or electricity, or immersion in hot water.)

1. Deep tissue destruction
2. Less pain because of nerve destruction

   (NOTE: Pain may be greatly diminished because nerve tissue has been burned.)

3. Charred or white appearance of burned area

XXVI. Guidelines for administering first aid to a victim with an eye injury

(NOTE: Extreme care should be taken in administering first aid for injuries of the eye. The eye is very sensitive and can easily be damaged further if the correct first-aid methods are not carried out.)

A. *Do not* let victim rub the eye

INFORMATION SHEET

B. *Do not* attempt to remove a foreign object by using any sharp object

EXAMPLES: Tweezers, toothpick

C. Keep victim flat on back if injury is caused by a penetrating object or severe blow; *do not* wash out eye with water; *do not* try to remove object penetrating the eye

(NOTE: For cuts and punctures of the eye or eyelid, get medical help at once.)

D. Cover eye with a clean dressing if foreign object is lodged in eye and cannot be removed easily by flushing with water or by using a clean cloth

(NOTE: Flushing of eye should be done with extreme care to avoid further injury, infection, or contamination to the other eye.)

E. Immediately flood with water any chemical substances in eye

XXVII. Signs and symptoms of fractures

(NOTE: An accurate diagnosis of a fracture can be made only by a physician with the assistance of an X-ray examination. The first-aid worker should suspect that a bone is broken. Even if there is doubt, if any one of the signs or symptoms of fractures is present, the first-aid worker should carry out first-aid measures for a fracture.)

A. Victim's account of accident

EXAMPLES: May have heard or felt a bone snap

May indicate location of pain and tenderness and difficulty moving injured part

May report grating sensation of broken bones rubbing together

May report abnormal or false movement in suspect area

B. Differences in shape and length of corresponding bones on the two sides of body

C. Obvious deformities

D. Swelling

E. Discoloration

F. Pain or tenderness to touch

G. Hemorrhage

(NOTE: Heavy loss of blood [hemorrhage] may occur especially if a hip is broken.)

INFORMATION SHEET

XXVIII. Guidelines for administering first aid to a victim with a suspected fracture

(NOTE: The objectives for administering first aid for fractures include [1] providing necessary first-aid care, [2] preventing broken bone ends and adjacent joints from moving, and [3] giving care for traumatic shock.)

A. Prevent motion of injured parts and adjacent joints

B. When an injured person obviously requires hospitalization and an ambulance is on the way, *do not* attempt to move victim unless there is a life-threatening emergency

EXAMPLES: Danger of fire, carbon-monoxide poisoning, explosion

C. Give priority to open fractures over closed fractures unless associated injuries dictate otherwise

D. *Never* test for fracture by having the victim move the possibly broken part or try to walk on a possibly broken leg

E. *Never* attempt to set or reduce a fracture or try to push a protruding bone end back in place

F. If possible, take time to tie victim's injured leg to uninjured one, or to bind injured arm to chest or side

G. *Do not* allow victim to move the head (and *do not* move it yourself) when there is a possible neck or spine fracture

H. Lift and move an unconscious victim as though the injury is to the neck or spine—provide rigid support for victim's back and head

I. After providing urgent care, treat to prevent traumatic shock

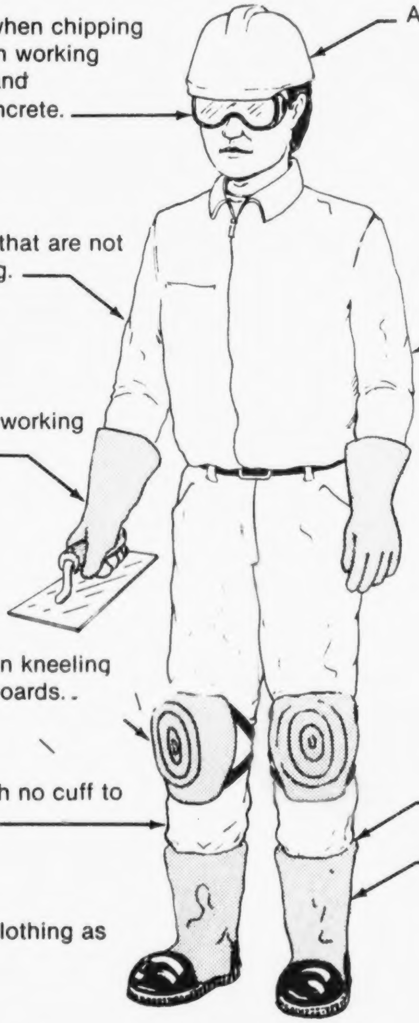
SAFETY AND BASIC FIRST AID
UNIT V

ASSIGNMENT SHEET #1 — IDENTIFY PROPER DRESS FOR A CONCRETE MASON

NAME ______________________ SCORE ______________

The properly dressed concrete mason is the worker who dresses safely for the job he or she performs. The illustration below depicts a worker who is dressed safely for most concrete masonry jobs. So that you will become familiar with safe on-the-job dress, study the illustration below, and then fill in the blanks on the illustration on the following page without referring to the drawing below.

The properly dressed concrete mason—



Wears goggles when chipping or grinding, when working around chutes, and when mixing concrete.

Always wears a hard hat.

Wears clothes that are not too loose-fitting.

Wears long-sleeved shirts to give extra protection if skin is sensitive.

Wears gloves when working with wet concrete.

Wears kneepads when kneeling on concrete or kneeboards.

Wears pants with no cuff to catch concrete.

Wears pants tucked into boots.

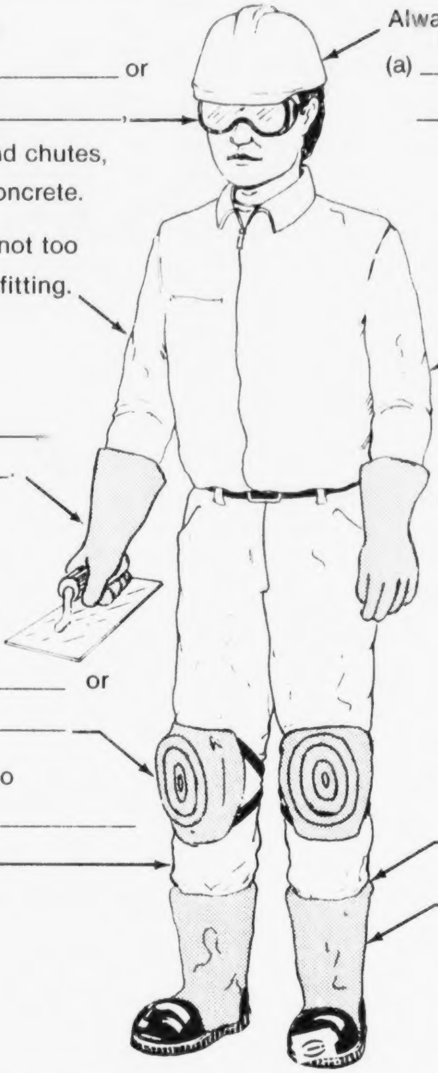
When wading in concrete, wears loose boots that are easy to slip on and off and are high enough to keep out wet concrete.

Keeps gloves and clothing as dry as possible.

Adapted with permission of the National Apprenticeship Program.

ASSIGNMENT SHEET #1

The properly dressed concrete mason—



Wears goggles when
(h) ____________________ or
(i) ____________________,
when working around chutes,
and when mixing concrete.

Wears clothes that are not too
(j) ______________-fitting.

Wears gloves
when working with
(k) ______________
______________.

Wears kneepads
when kneeling on
(l) ______________ or
(m) ______________

Wears pants with no
(n) ______________
to catch concrete.

Keeps gloves and clothing as
(o) ____________________ as possible.

Always wears a
(a) ____________________
____________________.

Wears long-sleeved
shirts to give
(b) ______________
____
if skin is sensitive.

Wears pants
(c) ______________
into (d) ______________.

When (e) ______________
in (f) ______________,
wears loose boots that are easy
to slip on and off and are high
enough to keep out
(g) ______________
______________.

Adapted with permission of the National Apprenticeship Program.

SAFETY AND BASIC FIRST AID
UNIT V

ASSIGNMENT SHEET #2 — VISIT A JOB SITE AND COMPLETE A SAFETY CHECKLIST

NAME ______________________________ SCORE ______________

One of the first steps to becoming safety conscious is being able to recognize safe on-the-job practices. Completing this assignment sheet will help you become more familiar with some of these practices.

Obtain permission to observe a job site for a few hours, and then fill out the checklist below. Write an "X" in the blank before any checklist item that is *not* being observed on the job site.

______A. Is adequate training and supervision visible?

______B. Are emergency telephone numbers posted?

______C. Are safety bulletins, posters, and charts displayed?

______D. Is knowledge of safety and first aid visible?

______E. Are inspection and accident reporting forms available?

______F. Is there any evidence of horseplay or scuffling that may tend to create a hazard?

______G. Is there any evidence of overloading ladders, scaffolds, or elevators?

______H. Is there indication of workers' using intoxicating liquors or drugs?

______I. Does all equipment have safety devices and grounds?

______J. Is the safety dress code being observed by all workers?

______K. Is an adequate work area provided?

______L. Are adequate walkways and runways provided?

______M. Are adequate stairways or elevators provided?

______N. Are ladders and scaffolds used safely?

______O. Are work areas and passageways clear of rubbish, debris, nails, etc.?

______P. Is there adequate illumination?

______Q. Is protection provided for floor and roof openings?

______R. Is protection provided for trenches and other excavations?

ASSIGNMENT SHEET #2

______S. Is there an adequate parking area?

______T. Is there adequate turnaround space?

______U. Are parking areas and drives free from excessive mud and trash?

______V. Is there separate storage for materials?

______W. Are there separate dump areas?

______X. Are toolsheds, office, and other structures safely and conveniently located?

______Y. Are power sources, high-voltage lines, and other electrical equipment located for safety and convenience?

______Z. Are sanitary facilities, first-aid stations, and drinking water located for safety and convenience?

______AA. Are safety materials and equipment on the job in good condition, and are they convenient when needed?

______BB. Is there proper auxiliary equipment for handling materials available on the job site?

______CC. Is there adequate space for maneuvering vehicles for elevating and handling materials?

______DD. Is there adequate space for loading and unloading equipment and materials?

______EE. Is there an adequate supply of the right tools for each part of the job?

______FF. Is there an adequate number of workers for jobs being performed?

______GG. On the blanks below, add any other safety violations or hazardous condition you may have observed.

____

____

____

____

____

____

____

SAFETY AND BASIC FIRST AID
UNIT V

ASSIGNMENT SHEET #3 — MATCH FIRE-EXTINGUISHER SYMBOLS TO GIVEN TYPES OF FIRES

NAME ________________________________ SCORE ______________

One of the dangers of working in the concrete masonry trade is that the worker is exposed to potential fire hazards. In fact, on most job sites, all four classes of fire are possible. Scrap lumber, rags, packaging, insulation, and other materials present the constant threat of a Class A fire. Class B fires can result from the wide use of gasoline and other flammable substances such as adhesives, solvents, paints, oils, and lubricants. Electrical wiring within the structure, the use of electrical tools and equipment, and the need for exposed outlets and extension cords can create numerous Class C fire hazards. Even Class D metal fires are a possibility because of welding, cutting, and other operations that produce high temperatures. Thus, it is critical that concrete masons be able to determine quickly the source of a fire in order to select the correct fire extinguisher to fight it.

In this assignment, you are presented with descriptions of several fires and are asked to choose the correct extinguisher to use on each fire. List only the minimum type of acceptable fire extinguisher. For example, if a fire is a Class A fire, list only the A-type extinguisher, even though you could use an A, AB, or ABC extinguisher on that particular fire.

Match the following fire-extinguisher symbols to the given types of fires. Write the correct number in the blanks.

_____a. Fire in the scrap lumber pile

_____b. Flames coming from the motor of an electrical concrete hammer

_____c. Metal studs burning near a reinforcement weld

_____d. Fire caused by cigarette ashes dropping into adhesive spreads over a plywood counter top

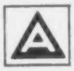
_____e. Fire near the carburetor of a gasoline-powered trowel machine

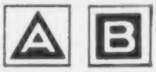
_____f. Smoke coming from a barrel of oily rags

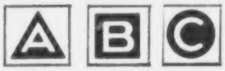
_____g. Smoldering insulation around a shorted electrical outlet

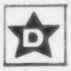
_____h. Wood shavings ignited by sparks from a concrete saw

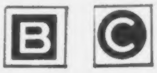
_____i. Electrical spray painter ignites

1. 

2. 

3. 

4. 

5. 

ASSIGNMENT SHEET #3

______j. Can of paint thinner spills, and the thinner bursts into flames when someone drops a lighted cigarette in it

______k. Space heater being used for winter finishing-work enclosure ignites

______l. Can of paint thinner explodes into flame, igniting wall containing exposed electrical outlets

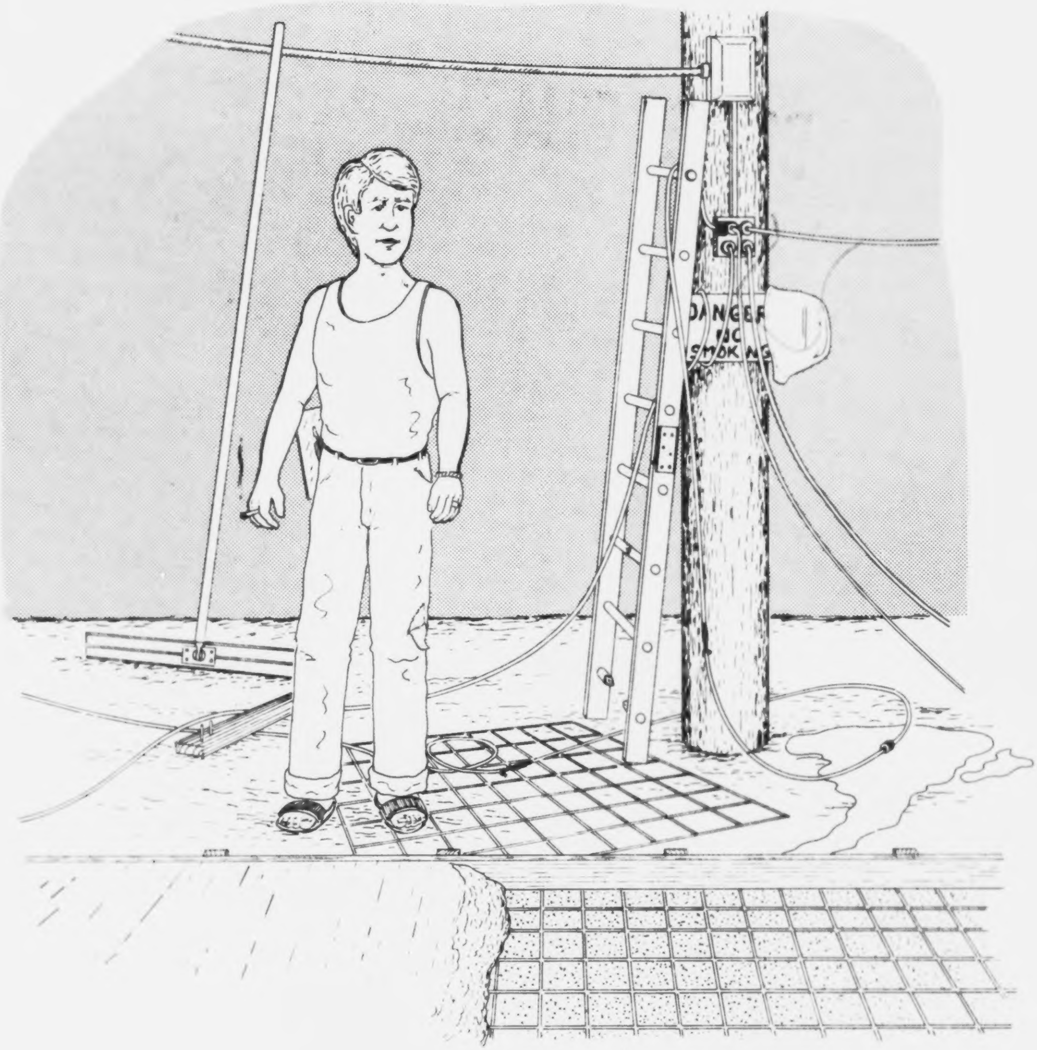
SAFETY AND BASIC FIRST AID
UNIT V

ASSIGNMENT SHEET #4 — IDENTIFY JOB-SITE AND SHOP SAFETY VIOLATIONS

NAME ______________________________ SCORE ______________

A skilled concrete mason must be constantly aware of threats to his or her safety and to the safety of others in the work area. The concrete masonry profession requires workers to use many dangerous tools and work in areas where an accident is possible with even momentary carelessness. To help you become more aware of these possible dangerous situations, study the illustration on the following page and identify the hazardous conditions or practices that exist. Write your list of these dangerous conditions or practices on the blanks below.

ASSIGNMENT SHEET #4


DANGER
NO
SMOKING

SAFETY AND BASIC FIRST AID
UNIT V

ASSIGNMENT SHEET #5 — ANALYZE CASE STUDIES TO DETERMINE CORRECT FIRST-AID TREATMENTS

NAME ______________________________ SCORE ____________

Quick and effective use of first-aid procedures can save your life or the lives of your co-workers. Even in situations that are not life-threatening, first aid can reduce the seriousness of an injury or prevent it from becoming life-threatening. The first step in any emergency situation is to determine the nature and extent of the injuries so that you can determine the proper treatment.

Read the situations described below and decide what kind of treatment is required. When requested, state the suspected type of injury (problem) based on the description, and then outline the basic emergency first-aid steps (treatment) you would take and the order in which you take them. Be specific enough to show that you understand the basic treatment.

A. A co-worker has shot a pin from a powder-actuated fastener through his boot and into his foot. The pin came out, and there is minimal bleeding. However, a few minutes later, he complains of feeling queasy. You notice that he is pale and that his skin feels cold and clammy. After a moment, he says that he feels weak and wants to rest. What is the problem and how should it be treated?

Problem: ____

Treatment: ____

____

____

____

____

____

B. One of the painters was spraying near an open flame from a gas water heater. The spray ignited in a flash fire. The painter has burns over his face, hands, and forearms. He is experiencing intense pain when you arrive. His hands are swollen and covered with blisters. They appear to be wet, almost waxy. His eyebrows are burned away, and his face looks puffy, and it is covered with scattered blisters and dark red patches. What kind of burn does he have, and how do you treat it?

Problem: ____

ASSIGNMENT SHEET #5

Treatment: ______________________________

C. A concrete mason working near you has run her hand into a power-hand-saw blade. Blood is gushing from the wound where the little finger has been severed and from a gash across her palm. When you wipe away the blood, streaks of white from tendons or bones show for a moment and then immediately disappear in the flow of blood. What actions should you take?

Treatment: ______________________________

D. One of your co-workers screamed when he was plugging a grinder into a gang outlet lying on the slab of a building. There was a popping sound and a puff of smoke. The co-worker fell over and lay motionless on the floor. You turn off the electricity at the fuse box, and rush to the victim. On checking him, you find that his hand is swollen, mottled red, and smoke-scorched. Additionally, you notice that his lips and fingers are a bluish color. You check to see whether he is breathing and find no sign of breath, though there is a weak pulse. What is the problem? What treatment is required?

Problem: ______________________________

Treatment: ______________________________

ASSIGNMENT SHEET #5

E. While opening a can of epoxy, a concrete mason splatters the material into her eyes when the lid flies off suddenly. She grabs her eyes and begins screaming, "It burns!" What should you do?

Treatment:

F. While finishing a roof slab on a hot August day, one of your co-workers begins to complain of being dizzy. You notice that he is sweating heavily and looks pale. Suddenly, he straightens out his left leg and begins rubbing the calf and thigh. He pulls up his pants leg, and you can see the muscles in his leg jerking spasmodically. What is the problem? What treatment should you provide?

Problem:

Treatment:

G. One of the concrete masons on your job was starting a portable, gasoline-powered generator when there was a loud explosion. You look up to see her covered in flames. She begins running toward you, screaming. You knock her down and roll her on the ground to smother the flames. The generator continues to burn, but you have extinguished the flames on the victim's clothing. She is unconscious but breathing. Her pulse is rapid but weak. Her clothing is burned badly. Her legs are covered with ashy white burns surrounded by dark brown and black areas. Charred cloth from her pants is embedded in the burns. There is considerable blistering on her stomach, face, and hands. What is the problem? How should you care for this accident victim?

Problem:

ASSIGNMENT SHEET #5

Treatment: ______________________________

H. You and a co-worker are working at a remote building site 30 miles away from the nearest medical help. Your co-worker, who is carrying a bag of cement, slips and falls. The bag of cement falls out of his hands and lands on his lower leg. Upon questioning him and examining his leg, you discover that his lower leg is bent at an odd angle, and that there is discoloration, swelling, and considerable pain and tenderness at the injury site. What is the problem, and how would you treat it?

Problem: ______________________________

Treatment: ______________________________

SAFETY AND BASIC FIRST AID
UNIT V

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

a. Hard hat
b. Extra protection
c. Tucked
d. Boots
e. Wading
f. Concrete
g. Wet concrete
h. Chipping
i. Grinding
j. Loose
k. Wet concrete
l. Concrete
m. Kneeboards
n. Cuff
o. Dry

Assignment Sheet #2 — Evaluated to the satisfaction of the instructor

Assignment Sheet #3

a. 1
b. 3
c. 4
d. 2
e. 2
f. 2
g. 3
h. 1
i. 5
j. 2
k. 1
l. 5

Assignment Sheet #4 — Evaluated to the satisfaction of the instructor; however, suggested answers are given below

a. Wearing sandals — improper footwear
b. Wearing ragged trousers with cuffs
c. Wearing jewelry
d. Not wearing gloves
e. Smoking in No Smoking area
f. Carrying trowel in pocket
g. Wearing sleeveless shirt
h. Not wearing a hard hat
i. Not wearing eye protection
j. Bull float leaning on electrical wires
k. Nails sticking up from board
l. Extension cord not plugged in tightly and lying on ground where it will get wet from concrete pour
m. Ragged extension cord lying on wire mesh and near water puddle
n. Extension cord hanging down in front of ladder and near puddle
o. Extension cords lying across ladder and strung out where people could hang themselves
p. Extension cord and ladder hiding No Smoking sign

ANSWERS TO ASSIGNMENT SHEETS

q. Ladder setting on uneven wire mesh
r. Using improperly supported, spliced ladder with broken rungs

Assignment Sheet #5

A. Problem: Traumatic shock

Treatment:

1. Keep victim lying down
2. If victim feels faint, raise feet and legs if moving the legs does not cause injury or pain
3. If victim is having difficulty breathing, raise the head and shoulders to maintain adequate supply of oxygen
4. Cover victim to prevent loss of body heat and to stabilize blood circulation

B. Problem: Second-degree burn

Treatment:

1. Prevent traumatic shock
2. Examine victim carefully
3. Treat for second-degree burns
4. Seek medical help
5. Continue checking and assisting until medical help is obtained

C. Treatment:

1. Control heavy bleeding by direct pressure
2. Prevent traumatic shock
3. Examine victim carefully
4. After providing urgent care, transport victim and severed finger to hospital
5. Continue checking and assisting until medical help is reached

D. Problem: Respiratory failure and electrical burns caused by electrical shock

Treatment:

1. Restore breathing
2. Prevent traumatic shock
3. Examine victim carefully
4. Treat electrical burn on hand just as you would treat a second-degree heat burn
5. Seek medical help
6. Continue checking and assisting until medical help is obtained

ANSWERS TO ASSIGNMENT SHEETS

E. Treatment:

1. Do not let victim rub eyes
2. Immediately flood eyes with water from a tap, drinking fountain, or hose, and continue flushing for fifteen minutes; then cover eyes with clean dressing
3. Prevent traumatic shock
4. Seek medical help
5. Continue checking and assisting until medical help is obtained

F. Problem: Heat cramps (probably a signal of oncoming heat exhaustion)

Treatment:

1. Rescue co-worker by helping him off roof and out of sun, preferably to an air-conditioned room
2. Treat for heat cramps by applying firm pressure and warm, wet towels to cramped area, and by giving sips of salt water

G. Problem: Loss of consciousness due to traumatic shock and second- and third-degree burns over a considerable portion of body

Treatment:

1. Call for assistance, directing someone to extinguish the generator fire, and directing someone else to call for an ambulance
2. Treat to prevent traumatic shock
3. Treat blistered areas of stomach, face, and hands for second-degree burns; cover eyes with a clean, dry cloth
4. Treat burns on legs as for third-degree burns; *do not* remove the charred pieces of cloth from burns
5. Continue checking and assisting until medical help arrives

H. Problem: Suspected fracture

Treatment:

1. Examine victim carefully
2. Treat to prevent traumatic shock
3. Prevent motion of injured leg and adjacent joints by splinting leg
4. Seek medical help (in this case, you will have to transport the victim to the hospital, taking care not to move the injured leg)

SAFETY AND BASIC FIRST AID
UNIT V

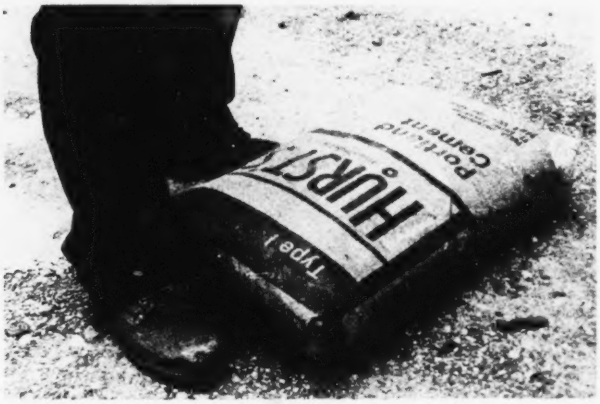
JOB SHEET #1 — PROPERLY LIFT A HEAVY OBJECT

I. Equipment — Heavy object

II. Procedure

A. Step up to object; place one foot beside object and one behind (Figure 5)

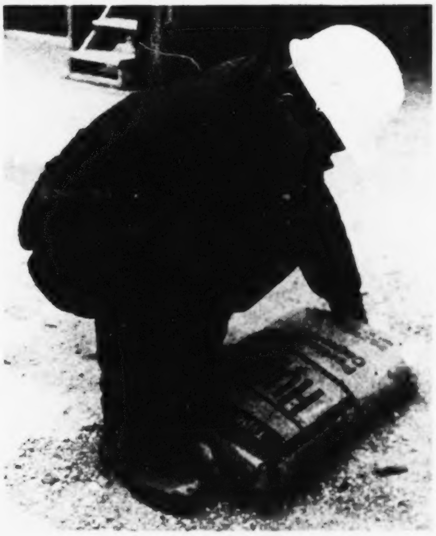
FIGURE 5



B. Bend the knees and get a good handhold on the object (See Figure 6)

C. Tuck in chin (Figure 6)

FIGURE 6

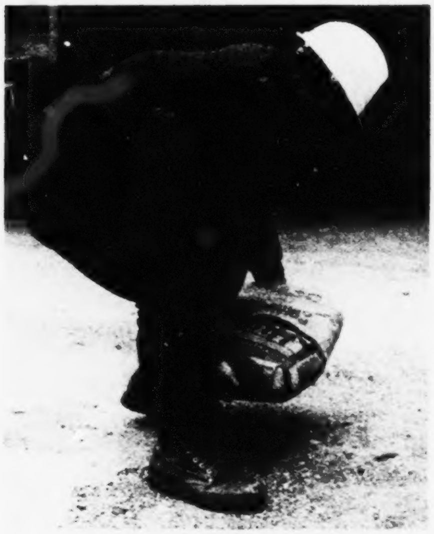


JOB SHEET #1

D. Tuck in elbows and arms (See Figure 7)

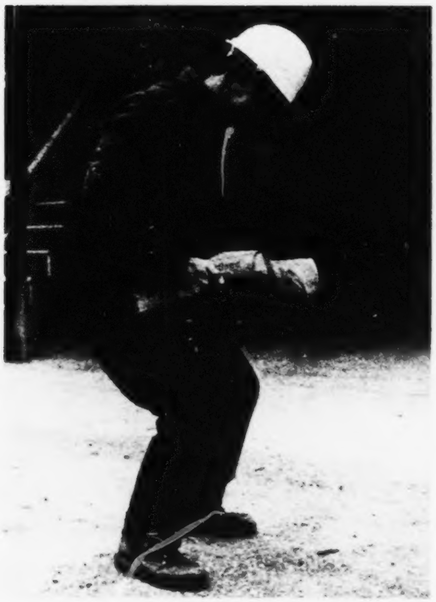
E. Hold load close to body (Figure 7)

FIGURE 7



F. Keeping back straight and body weight directly over feet, push with your legs as you stand straight up (Figure 8)

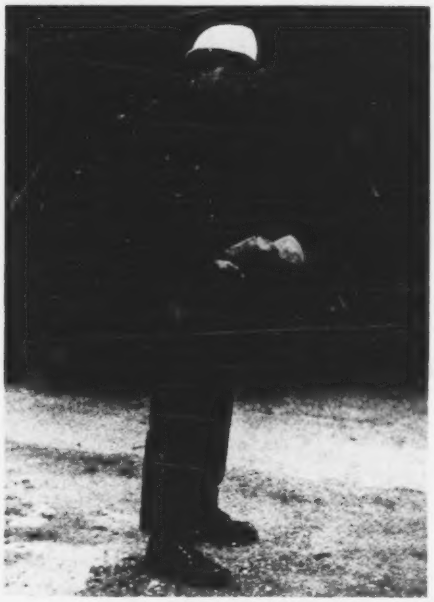
FIGURE 8



JOB SHEET #1

G. Lift the object into carrying position, making no turning or twisting movements until lift is completed (Figure 9)

FIGURE 9



SAFETY AND BASIC FIRST AID
UNIT V

JOB SHEET #2 — PERFORM FIRST-AID TREATMENT FOR SIMULATED ACCIDENT VICTIMS

I. Equipment and materials

   A. Resuscitation doll

      (NOTE: Never practice CPR on a breathing person.)

   B. Clean dressings (prepared gauze, clean handkerchiefs, clean articles of clothing)

   C. Blankets

   D. Water and basin

   E. Rubbing alcohol

   F. Salt

   G. Cup or glass

   H. Sterile dressings (gauze pads and cotton)

   I. Splint material

   J. Strips of material for securing splints

   K. Towels

II. **Procedure for adult victim of suspected cardiopulmonary arrest**

   A. Determine unresponsiveness

      1. Tap or gently shake victim's shoulder

      2. Shout, "Are you okay?"

         (NOTE: This procedure is recommended as the person may be asleep.)

   B. *If* victim remains unresponsive, call for help

      (NOTE: Call out to alert bystanders so that they will know help is needed.)

   C. Position victim for cardiopulmonary resuscitation (CPR)

      1. Place victim flat on back, turning victim as a unit while supporting his or her head and neck (See Figure 10)

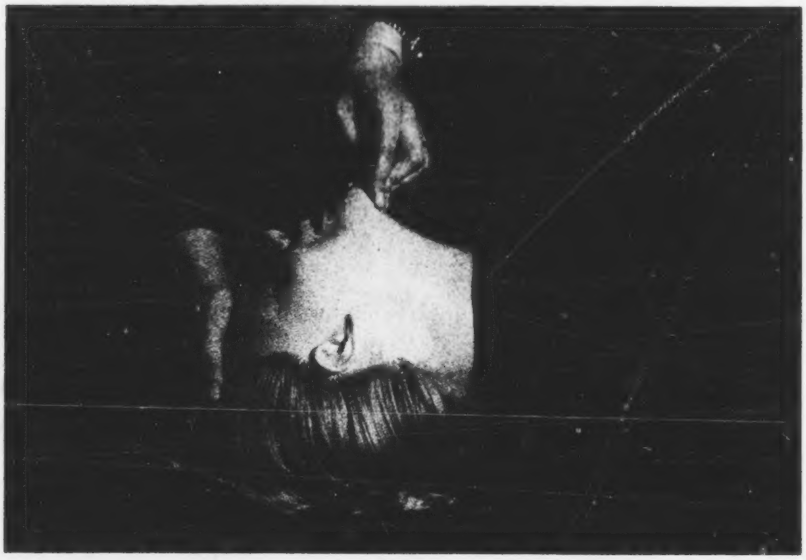
JOB SHEET #2

FIGURE 10

2. Open victim's airway, using head-tilt/chin-lift maneuver—tilting back victim's head while lifting victim's chin (Figure 11)

   (NOTE: The head-tilt/chin-lift maneuver positions victim's tongue to prevent obstruction of the airway.)

FIGURE 11

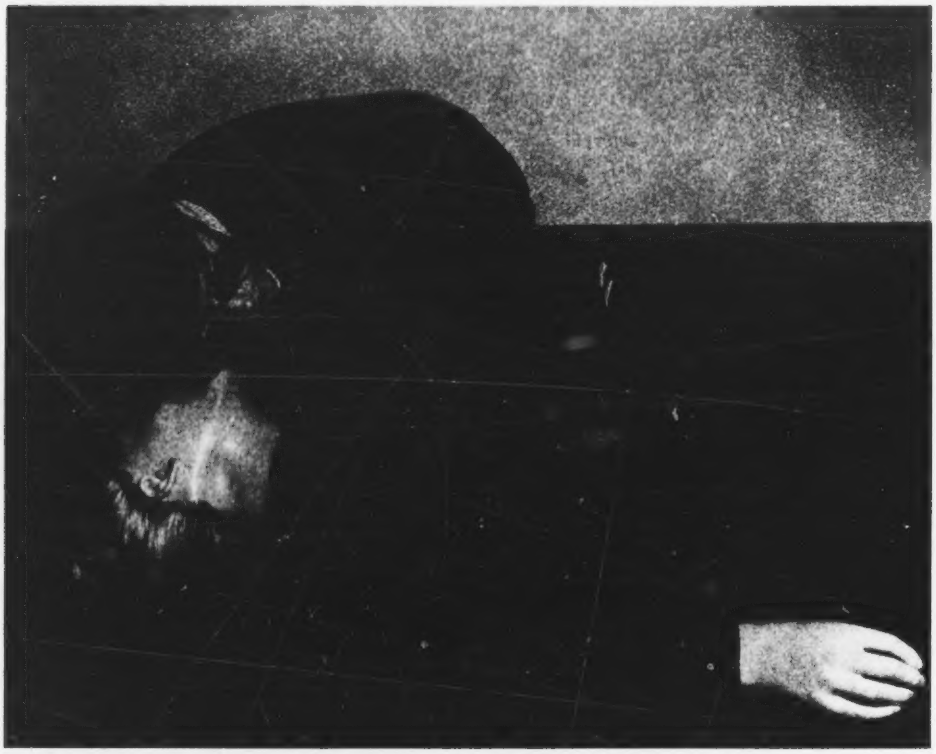


JOB SHEET #2

D. Determine breathlessness

1. Use head-tilt/chin-lift maneuver to maintain open airway
2. Place your ear over victim's mouth and observe the chest for movement while listening and feeling for breathing: look, listen, and feel (Figure 12)

FIGURE 12



E. *If* victim is not breathing, ventilate victim

CAUTION

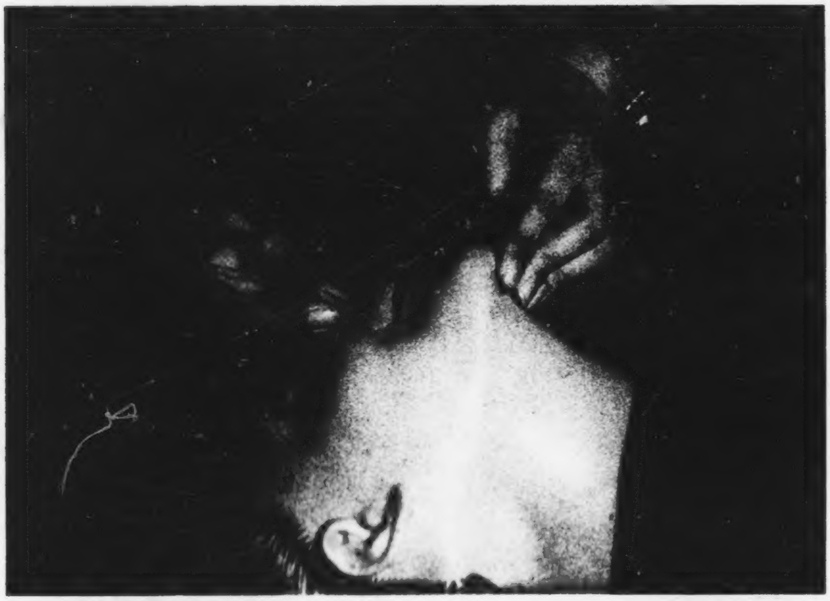
Do not ventilate a breathing person.

1. Use head-tilt/chin lift maneuver to maintain open airway
2. Pinch victim's nostrils shut (See Figure 13)

   (NOTE: Pinching the victim's nostrils prevents air from escaping through the nose during ventilation.)

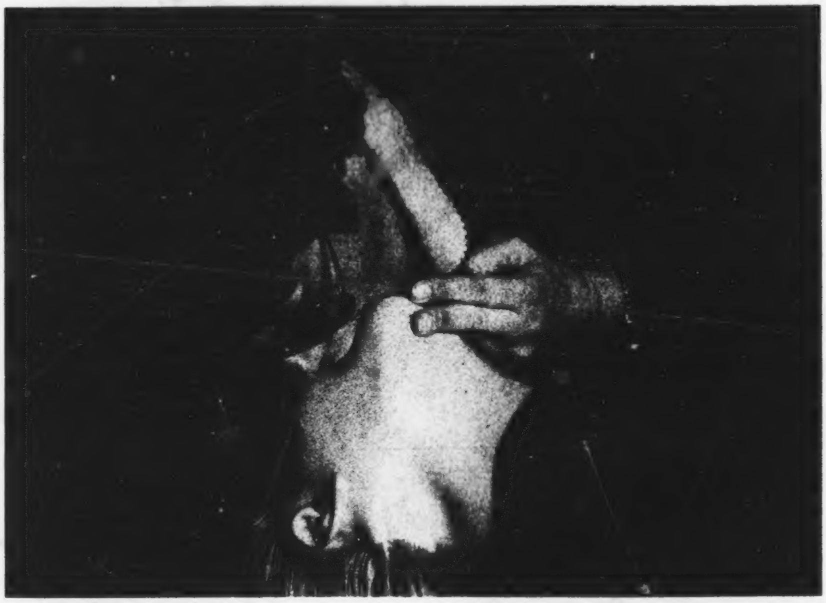
JOB SHEET #2

FIGURE 13



3. Cover the victim's mouth with your mouth, making as airtight a seal as possible (Figure 14)

FIGURE 14



JOB SHEET #2

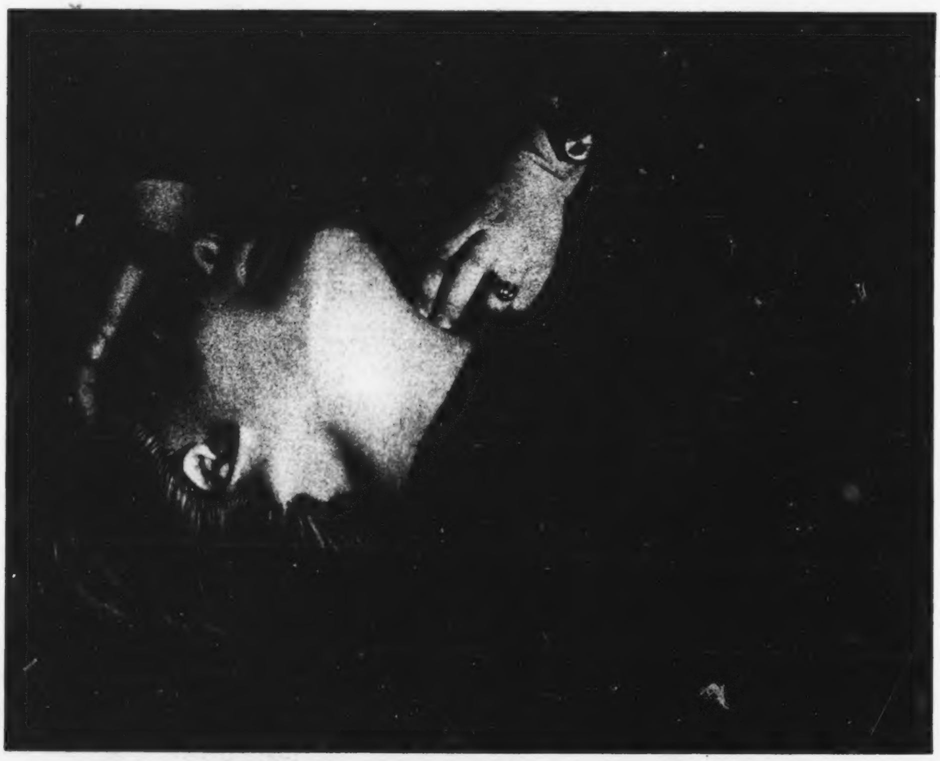
4. Ventilate by breathing into victim's mouth 2 times at a rate of 1 to 1 1/2 seconds per inspiration, while watching for chest rise

> **CAUTION**
>
> Remove your mouth from the victim's mouth and allow victim's chest to deflate between ventilations.

F. Determine pulselessness

1. Maintain head tilt with one hand on victim's forehead (See Figure 15)
2. Using hand that was on victim's chin, feel for carotid pulse on near side of victim (Figure 15)

FIGURE 15



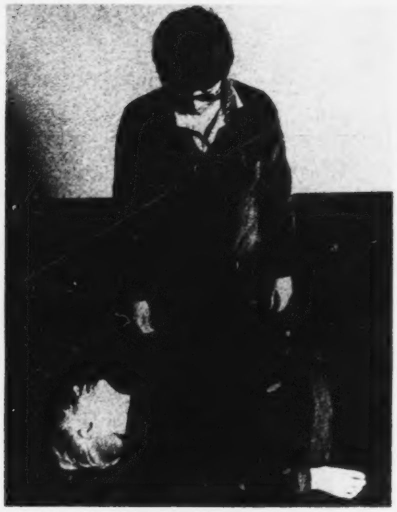
G. If someone responded to call for help, send him or her to call for an ambulance; give local emergency number if known

H. If victim has no pulse, begin chest compressions

1. Kneel beside victim's shoulders (See Figure 16)

JOB SHEET #2

FIGURE 16



2. Establish landmark (hand position)

   a. Beginning at victim's side, locate bottom of rib cage (See Figure 17)

   b. Run your fingers along bottom of rib cage and then up at center of rib cage to locate bottom of sternum—bone that connects the ribs (See Figure 17)

   c. Measure 2 to 3 finger widths up from bottom of sternum to establish landmark (Figure 18)

FIGURE 17

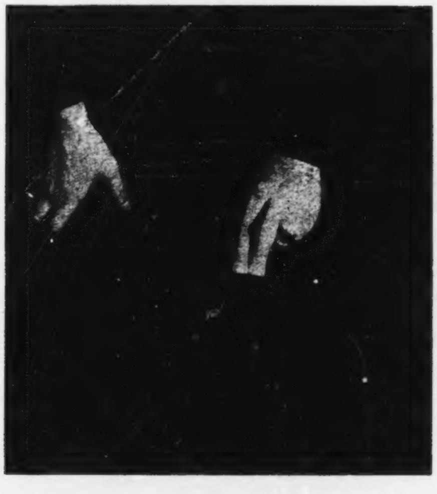
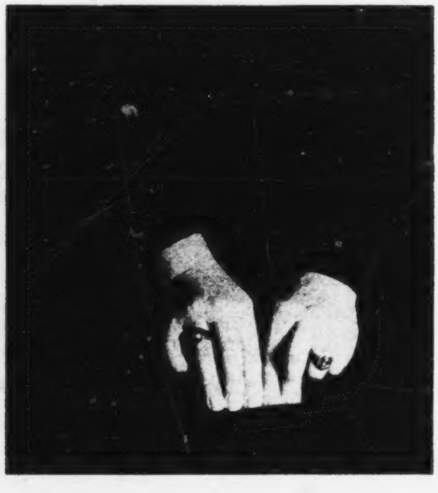


FIGURE 18

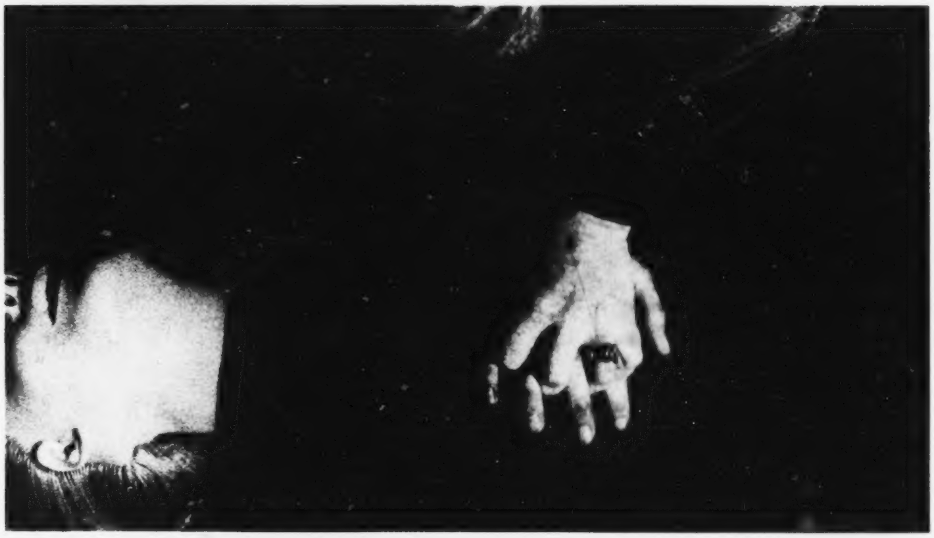


JOB SHEET #2

3. Position *heel* of one hand on landmark, place other hand on top, and interlace fingers (Figure 19)

> **CAUTION**
>
> Improper hand position can cause broken ribs, punctured lungs, and lacerated liver or spleen. Apply pressure with heel of hand only.

FIGURE 19



4. Deliver 15 compressions within 9 to 11 seconds, using the following guidelines
   a. Keep your shoulders over victim's sternum
   b. Keep arms straight
   c. Maintain an equal compression/relaxation ratio
   d. Compress victim's chest to a depth of 1 1/2 to 2 inches
   e. Keep hands on victim's sternum during upstroke
   f. Relax pressure on victim's chest completely on upstroke
   g. Repeat a phrase such as "One and two and three and..." to maintain a rate of from 80 to 100 compressions per minute

I. Ventilate victim

1. Use head-tilt/chin-lift maneuver to open airway

JOB SHEET #2

   2. Seal mouth and nose
   3. Deliver 2 ventilations at a rate of 1 to 1 ½ seconds per inspiration; watch for chest movement

> **CAUTION**
>
> Remove your mouth from the victim's mouth and allow victim's chest to deflate between ventilations.

J. Deliver 3 more sets of 15 compressions to 2 ventilations

K. Reassess pulse by checking carotid artery

L. *If* pulse is absent, continue CPR

   1. Ventilate twice, watching for chest to rise
   2. Resume cycles of 15 compressions to 2 ventilations (Steps H and I)
   3. Check carotid pulse every few minutes

M. *If* pulse is present, open airway and evaluate breathing

   1. Use head-tilt/chin-lift manuever to open airway
   2. Look, listen, and feel for breathing

N. *If* breathing is absent, perform ventilations at 12 times per minute, while monitoring pulse

O. *If* breathing is present, maintain open airway and monitor pulse and breathing until medical help arrives

Adapted from 1985 National Conference on Standards and Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiac Care and Deliberations of the AHA ECC Committee, copyright American Heart Association, April, 1986.

III. **Procedure for bleeding victim**

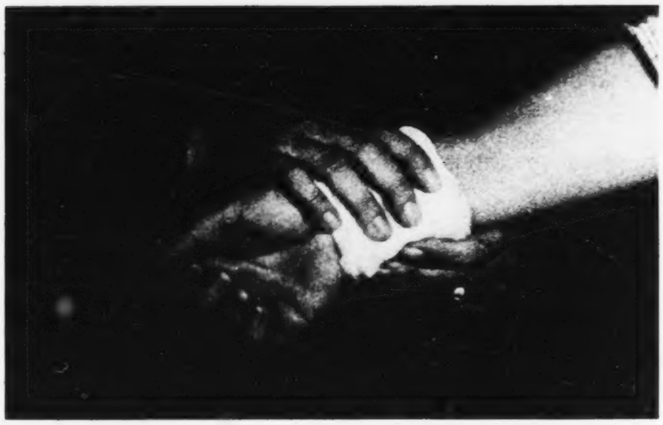
> **CAUTION**
>
> *Never* remove a penetrating object from a wound as this could be fatal for the victim. Apply bulky dressing around the object as best as you can to stabilize the object. Direct pressure and elevation will stop bleeding from most wounds.

A. Apply a thick dressing (prepared gauze, clean handkerchiefs, clean articles of clothing) directly over wound, and press firmly with hand (See Figure 20)

(NOTE: If no dressings are available, use your bare hand until a suitable dressing can be found.)

JOB SHEET #2

FIGURE 20



B. Elevate wound when you apply direct pressure if it *does not* cause victim pain and you *do not* suspect broken bones

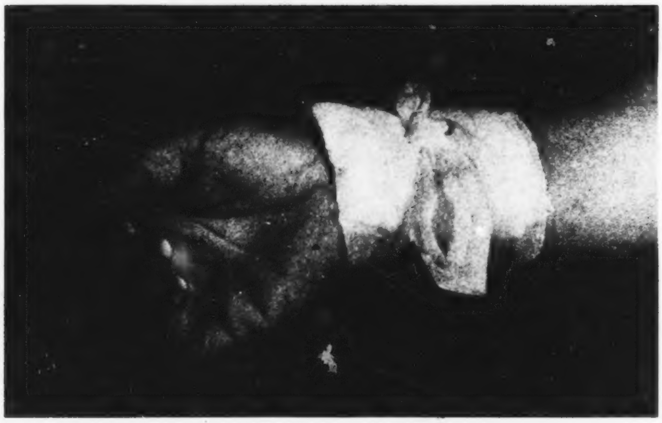
C. Observe dressing frequently to see whether bleeding has stopped or slowed

CAUTION

Do not disturb blood clots after they have formed. If blood soaks through dressing, *do not* remove dressing, but add more layers.

D. *If* bleeding is still active, apply a pressure bandage by holding the dressing in place with one hand, wrapping bandage directly over and around wound, and tying knot over wound; *do not* reduce pressure (Figure 21)

FIGURE 21



JOB SHEET #2

E. *If* bleeding continues, keep using direct pressure (and elevation when suitable), but also use a pressure point

(NOTE: *Do not* use a pressure point for an arm or leg wound unless direct pressure and elevation *do not* stop the bleeding.)

F. When bleeding is under control, gradually release the pressure point

G. Treat victim to prevent traumatic shock

(NOTE: A victim may suffer shock and loss of consciousness from loss of blood. Because it is possible to bleed to death in a very short period of time, bleeding should be given urgent care.)

1. Keep victim lying down
2. If victim is bleeding from the mouth, place victim on one side so the blood will drain from mouth (Figure 22)

FIGURE 22

3. **If victim feels faint, raise feet and legs**—but *only* if moving the legs does not cause injury or pain (Figure 23)

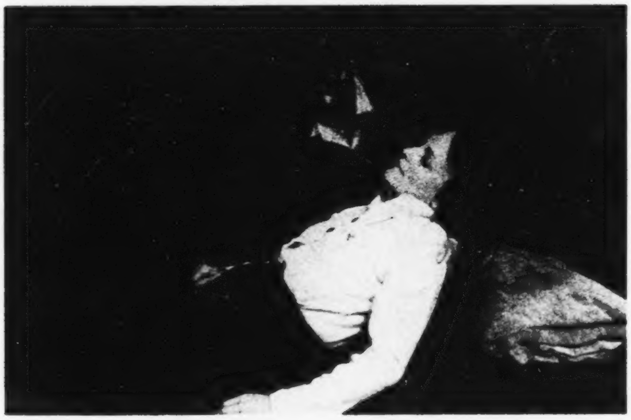
FIGURE 23

JOB SHEET #2

4. If victim is having difficulty breathing, raise the head and shoulders to maintain adequate supply of oxygen (Figure 24)

> **CAUTION**
>
> Raising only the head may bend the neck and block the airway. *Do not* raise head and shoulders if you suspect a neck or back injury.

FIGURE 24



5. Cover victim to prevent loss of body heat

6. Give *no* fluids or foods

H. Get medical help as soon as possible

IV. **Procedure for victim of heat distress**

A. Heat stroke

(NOTE: Heat stroke is always a life-threatening situation. In heat stroke, the victim's temperature-control system, which causes sweating, stops working correctly. The body temperature rises so high that brain damage and death will result if the victim is not cooled quickly.)

1. Move victim out of sun, preferably to an air-conditioned room

2. Cool the body immediately by soaking victim in cool but not cold water, sponging the body with rubbing alcohol or cool water, or pouring water on the body

3. When victim's body temperature has been reduced to a safe level (about 102°F), stop cooling process and observe the victim for about 10 minutes

JOB SHEET #2

4. If temperature starts to rise again, cool the victim again

   (*NOTE: Use fans, air conditioners, or fan by hand to circulate air and promote cooling. Do not* give coffee, tea, or alcoholic beverages.)

5. Transport to hospital immediately

B. Heat exhaustion

1. Move victim out of sun, preferably to an air-conditioned room
2. Loosen victim's clothing; apply cool, wet cloths; and fan to promote cooling
3. Give *sips* of salt water (2 pinches of salt per glass of water) every 15 minutes for an hour

   CAUTION

   If victim is vomiting, give no fluids.

4. Have victim remain lying down, and raise victim's feet 10 to 12 inches
5. Transport victim to hospital

   (NOTE: Medical care is needed for heat exhaustion.)

C. Heat cramps

CAUTION

If left untreated, the victim of heat cramps may develop heat stroke.

1. Move victim out of sun, preferably to an air-conditioned room
2. Have victim lie down
3. Apply firm pressure and warm, wet towels to cramped area
4. Give *sips* of salt water as for heat exhaustion
5. Have victim remain lying down, and raise victim's feet 10 to 12 inches

V. **Procedure for burn victim**

A. First-degree burns

1. Apply cold water or submerge burned area in cold water
2. Apply a dry, sterile dressing to protect injury if necessary

JOB SHEET #2

B. Second-degree burns

1. Submerge burned area in cold water until pain eases, or apply cold, wet cloths

   (NOTE: *Do not* use ice water.)

2. Blot dry gently with sterile dressing or clean, lint-free cloths

3. Apply dry, sterile dressing, using care not to break blisters

   CAUTION

   Do not apply cream, ointments, sprays, or other substances to burn.

4. Get medical help as soon as possible

C. Third-degree burns

1. *If* burning process has not stopped

   a. Remove any smoldering clothing

   b. Immerse burned area in clean, cold water

   CAUTION

   Do not apply water to burn or immerse burn in water UNLESS burning process has not been stopped.

   Immerse burned area for no more than 10 minutes. Prolonged immersion may cause life-threatening loss of body heat.

2. When burning process has stopped, cover burn with dry, thick, sterile dressing

3. Immobilize burned area as much as possible

4. Monitor victim's breathing and circulation

5. Treat to prevent traumatic shock

6. Transport victim to hospital as quickly as possible

VI. **Procedure for victim with foreign object or substance in eye**

(NOTE: In an urgent-care situation involving a victim with an object or substance in the eye, flush the eye immediately with water from a water fountain or from a gently running hose or faucet. *Never* use a hose that is fitted with a power nozzle.)

A. Wash hands

JOB SHEET #2

B. Explain procedure to victim

C. Position victim on affected side

(NOTE: This is done so that the contaminated fluid does not run from the affected eye to the good eye.)

D. Moisten a sterile gauze pad with water and clean any debris from eyelid *only if* there is no foreign object in eye

> **CAUTION**
>
> Always wipe from inner to outer side to prevent contamination. If you suspect a foreign object in the eye, *do not* press on the eyelid as that may cause the object to embed.

E. Use thumb and index finger to open eyelid

F. Flush eye by gently directing a stream of room-temperature water into inner side of eye

> **CAUTION**
>
> *Do not* touch the edge of the water container to the eye.

G. Flush eye for at least 15 minutes, especially if condition is caused by a caustic substance

H. Save flushed-out foreign object if this is what has caused the condition

I. Gently place sterile gauze pad over both eyes

J. Transport victim to hospital immediately

VII. **Procedure for victim with suspected fracture**

A. Closed fracture

1. Ask victim what happened and what hurts

2. Examine victim carefully

> **CAUTION**
>
> *Do not* move or have the victim move body parts that may be injured.

(NOTE: After your initial examination, you will know whether an ambulance is needed. If such is the case, ask someone to call for an ambulance while you attend to the victim.)

JOB SHEET #2

3. *If* you cannot get immediate medical help, immobilize the joints above and below suspected fracture with splints, taking care to move the bones as little as possible

   (NOTE: There are many types of splints available commercially; however, very satisfactory emergency splints can be made from corrugated cardboard, newspapers, boards, straight sticks, or rolled blankets.)

   a. Choose or create a splint long enough to extend past the joints on either side of suspected fracture

   b. Slide splints into place, taking care to move the bones as little as possible

   c. Place padding (folded cloths, dressings, handkerchiefs, etc.) between splint and skin, especially over bony places

   d. Hold splints in place with strips of cloth torn from clothing or with bandages, neckties, large handkerchiefs, or other suitable material

   CAUTION

   Do not cut off circulation by tying the cloth strips too tightly.

   e. In fractures of the arm or leg, inspect fingers and toes often for swelling or bluish discoloration—signs that the bandages are too tight

   f. Loosen bandages and reapply them if these signs appear

4. Elevate limb slightly to reduce hemorrhage and swelling

5. Treat to prevent traumatic shock

6. Transport victim to hospital if an ambulance is not needed

B. Open fracture

(NOTE: Open fractures are much more serious than closed fractures because of tissue damage and bleeding, the danger of infection, and the fact that the fracture area is always contaminated.)

1. Remove or cut away victim's clothing in area of suspected fracture

2. Examine victim carefully

   CAUTION

   Do not move or have the victim move body parts that may be injured.

   (NOTE: After your initial examination, you will know whether an ambulance is needed. If such is the case, ask someone to call for an ambulance while you attend to the victim.)

JOB SHEET #2

3. *If* bone fragment *is not* protruding, control hemorrhage by applying pressure through a thick, sterile dressing over wound

> **CAUTION**
>
> *Do not* wash the wound, probe the wound, or insert your fingers in it.

4. *If* bone fragment *is* protruding, cover entire wound with large, thick, sterile bandage compress or pads; if these are not available, use freshly laundered sheets or towels

> **CAUTION**
>
> *Never* attempt to set or reduce a fracture or try to push a protruding bone end back in place.

5. *If* you cannot get immediate medical help, apply splints as described for closed fractures

6. Elevate limb slightly to reduce hemorrhage and swelling

7. Treat to prevent traumatic shock

8. Transport victim to hospital if an ambulance is not needed

VIII. **Procedure for victim of poisoning**

A. Inhaled toxic gases, vapors, or mists

1. Remove victim to source of fresh air

> **CAUTION**
>
> If the victim is in an enclosed area, *do not* attempt to rescue victim; call the fire department or rescue squad.

2. While you attend to victim, direct someone to call an emergency squad

   (NOTE: The person who calls the emergency squad must indicate the nature of the problem and explain that oxygen should be brought to the scene.)

3. Loosen victim's tight clothing

4. If victim is unconscious, keep an open airway and give artificial respiration or CPR if indicated

5. Save label from or container of suspected poison for identification

6. Continue checking and assisting victim until medical help arrives

JOB SHEET #2

B. Absorption or skin contact with harsh or corrosive substance

1. Remove victim's contaminated clothing
2. Immediately drench and flush affected skin with large quantities of water
3. *If* poisoning is from corrosive substance, send for an ambulance immediately
4. Continue washing all contaminated skin with soap and water for at least 5 minutes
5. Keep victim's airway open and give artificial respiration if indicated
6. Continue checking and assisting victim until medical help arrives

C. Ingested poison

1. Dilute poison by having victim drink a glass of water or milk *if* victim is conscious and not having convulsions and *if* ingested substance is not corrosive

   (NOTE: Discontinue dilution if it makes victim nauseated. If victim does vomit, save a sample of the vomit for identification of the poison.)

2. Seek medical assistance by calling poison control center or a physician

   (NOTE: You should post the poison control number for your region on your telephone. If you do not have the number, dial 0 or 911.)

3. If victim is unconscious, keep victim's airway open and give artificial respiration or CPR if indicated
4. Save label from container of suspected poison for identification
5. Continue checking and assisting victim until medical help arrives

IX. **Procedure for victim of frostbite**

A. Remove victim from further exposure to cold

B. Protect affected area from further injury

CAUTION

Do not rub affected area. Rubbing will cause further damage. Always handle affected area gently.

JOB SHEET #2

C. Remove wet or restrictive clothing

D. Cover affected area with a dry, sterile dressing

E. Keep victim warm

F. Monitor victim's breathing and circulation

G. Obtain medical assistance as quickly as possible

SAFETY AND BASIC FIRST AID
UNIT V

TEST

NAME ____________________________ SCORE ______________

1. Match terms and definitions associated with safety. For each of the following definitions, select the term listed with that definition in the information sheet, and then write the correct number in the blank.

______a. Tending to blow up or burst violently and loudly

1. Combustible
2. Explosive
3. Flammable

______b. Any suddenly occurring, unintentional event that causes injury or property damage

1. Mishap
2. Accident
3. Hazard

______c. Federal legislation designed to ensure safe and sanitary working conditions for employees

1. MSHA
2. NIOSH
3. OSHA

______d. To put out a fire; to cause to cease burning

1. Extinguish
2. Quench
3. Smother

______e. Freedom from danger, risk, or injury

1. Security
2. Contentment
3. Safety

______f. Source of danger

1. Accident
2. Hazard
3. Mishap

______g. Stored under pressure greater than the pressure of the atmosphere

1. Pressurized
2. Explosive
3. Combustible

______h. National Institute for Occupational Safety and Health

1. MSHA
2. ACI
3. NIOSH

TEST

______i. Failure to think before one acts; failure to pay attention

1. Incompetence
2. Carelessness
3. Ignorance

______j. Capable of bursting into flames

1. Flammable
2. Combustible
3. Explosive

______k. Mine Safety and Health Administration

1. MSHA
2. AGC
3. ASTM

______l. Capable of being easily ignited; burning with extreme rapidity

1. Combustible
2. Flammable
3. Explosive

2. State two reasons why you must be safety conscious on the job.

a.

b.

3. State three consequences of a worker's using alcohol or drugs on the job.

a.

b.

c.

TEST

4. State job-safety rules for the following categories.

General safety (State three rules.)

a. ____

____

b. ____

____

c. ____

____

Personal safety (State four rules.)

a. ____

____

b. ____

____

c. ____

____

d. ____

____

Equipment and tool safety (State three rules.)

a. ____

____

b. ____

____

c. ____

____

TEST

Work-area safety (State three rules.)

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

Flammable-liquid safety (State three rules.)

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

Gasoline-powered-equipment safety (State three rules.)

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

Materials-handling safety (State three rules.)

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

TEST

5. State four safety precautions pertaining to scaffolds.

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

d. ______________________________

____

6. State four safety precautions pertaining to ladders.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

7. Match colors of the safety color code to their correct applications. Write the correct numbers in the blanks. Answers may be used more than once.

______a. Designates radiation hazards

______b. Designates safety starter buttons and parts of equipment that may cause electrical shock

______c. Designates items for housekeeping purposes

______d. Designates location of first-aid equipment

______e. Identifies fire-protection equipment and its location

______f. Designates waste containers for explosive or combustible materials

______g. Designates caution against and provides information about machines or equipment out of order or under repair

______h. Designates danger

1. Federal safety red
2. Federal safety yellow
3. Federal safety orange
4. Federal safety purple (or black or magenta on safety yellow)
5. Federal safety blue
6. Federal safety green
7. Federal safety black and white (used individually or in combination)

TEST

8. Match classes of fires to their correct descriptions. Write the correct numbers in the blanks.

_____a. Fires that occur with flammable liquids such as gasoline, oil, grease, paint, and thinners

_____b. Fires that occur in ordinary combustible materials such as wood, rags, rubber, and plastics

_____c. Fires that occur in or near electrical equipment such as motors, switchboards, and electrical wiring

_____d. Fires that occur with combustible metals such as iron, magnesium, sodium, and potassium

1. Class A
2. Class B
3. Class C
4. Class D

9. Match terms and definitions associated with toxic substances. For each of the following definitions, select the term listed with that definition in the information sheet, and then write the correct number in the blank.

_____a. To suck up or take up (as a sponge)

1. Digest
2. Absorb
3. Involve

_____b. To make impure or unclean; to bring into contact with dirt or other impurity from an outside source

1. Contaminate
2. Corrupt
3. Dilute

_____c. Having the nature of a poison

1. Corrupt
2. Dirty
3. Toxic

_____d. Moisture in the form of particles floating or falling in the air

1. Vapor
2. Fume
3. Mist

_____e. Liquid that dissolves or is capable of dissolving one or more other substances

1. Solvent
2. Thinner
3. Fuel

_____f. Diffused matter suspended in the air in a gaseous state as distinguished from the liquid or solid state

1. Smoke
2. Vapor
3. Exhaust

TEST

_____g. To cause itching, burning, and/or reddening
1. Perturb
2. Annoy
3. Irritate

_____h. Smoke, vapor, or gas; the suspension of microscopic particles in gas; engine exhaust
1. Fume
2. Carbon monoxide
3. Vapor

10. List eight toxic substances a concrete mason may contact on the job.

a. ______________________ e. ______________________

b. ______________________ f. ______________________

c. ______________________ g. ______________________

d. ______________________ h. ______________________

11. List forms of toxic substances.

a. ____

b. ____

c. ____

12. State three ways toxic substances enter the body.

a. ____

b. ____

c. ____

13. Define ways toxic substances affect the body.

a. Local effect — ____

____

b. Systemic effect — ____

____

14. Discuss consequences of exposure to toxic substances.

____

____

____

TEST

15 Select correct definitions of terms associated with first aid. Write an "X" in the blank before the best definition.

a. A *closed fracture* is a

______1. Compound fracture

______2. Broken bone beneath the skin with no open wound

______3. Broken bone that has been immobilized

b. *Resuscitation* is the

______1. Act of reviving a person by giving the person hot, black coffee and forcing him or her to walk

______2. Act of reviving a person by applying pressure directly to a wound

______3. Act of reviving a person by bringing the person back to full consciousness

c. *Traumatic shock* is a

______1. Depressed condition of many of the body functions due to failure of enough blood to circulate through the body

______2. Condition existing when skin is flushed, hot, and dry and body temperature is high

______3. Condition existing when skin surface is hard but underlying tissue is soft

d. A *hemorrhage* is a

______1. Flow of blood; mass of dilated veins in swollen tissue situated near the anal sphincter

______2. Heavy loss of blood

______3. Protrusion of an organ through connective tissue or through a wall of the cavity in which it is normally enclosed

e. *First aid* is the

______1. Rhythmic forcing of air into and out of the lungs of a person who has been injured

______2. Act of reviving an accident victim by bringing him or her back to full consciousness

______3. Immediate, temporary care given to the victim of an accident or sudden illness until the services of a physician can be obtained

TEST

f. An *open fracture* is a

______1. Simple uncovered fracture

______2. Broken bone that must be splinted and put in a sling

______3. Broken bone associated with an open wound

g. A *tourniquet* is

______1. Any device, such as a bandage and stick, used to compress a blood vessel to stop bleeding or to control blood flow

______2. Any clean bandanna compressed directly against the wound to control bleeding

______3. A triangular bandage made into a sling to hold the affected part until victim can get to hospital

16. State two reasons why knowledge of first aid is important.

a. ______________________________

____

b. ______________________________

____

17. List three concrete masonry job-related injuries that may require first aid.

a. ______________________________

b. ______________________________

c. ______________________________

18. Arrange in order first-aid actions to follow in an emergency. Write a "1" in the blank before the first step, a "2" in the blank before the second step, and so on.

______a. Control heavy bleeding

______b. Restore or maintain breathing and heartbeat

______c. Rescue victim and yourself

______d. Examine victim carefully

______e. Treat for poisoning

______f. Prevent traumatic shock

______g. Keep checking and assisting victim until medical help is obtained

______h. Seek medical help

TEST

19. Describe the symptoms of traumatic shock.

Early stages

Late stages

20. State four measures to take for prevention of heat stroke, heat cramps, and heat exhaustion.

a.

b.

c.

d.

TEST

21. Distinguish between symptoms of heat stroke and heat exhaustion. Write an "X" in the blank before symptoms of heat stroke.

_____a. Flushed, hot, dry skin and high body temperature

_____b. Pale, cool, clammy skin and normal body temperature

22. State four measures to take for prevention of frostbite.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

23. Describe symptoms of frostbite.

____

____

____

____

____

____

____

____

____

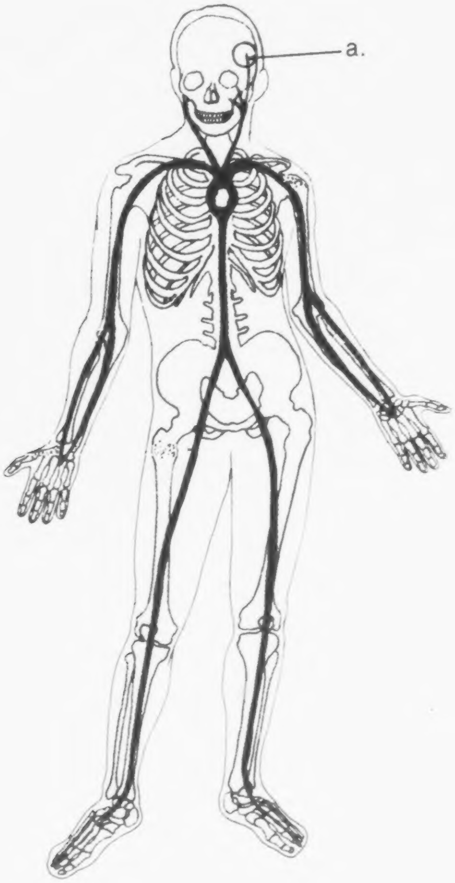
____

____

TEST

24. Identify pressure points to use to control bleeding from various areas of the body. Circle the pressure points in the illustration below, and then label each with the letter that corresponds to the area of bleeding it controls. (Pressure point "a" is shown as an example.)

a. Bleeding from scalp
b. Bleeding from face
c. Bleeding from thigh
d. Bleeding from lower leg
e. Bleeding from lower arm or elbow
f. Bleeding from upper arm or shoulder
g. Bleeding from neck
h. Bleeding from foot
i. Bleeding from lower arm or hand



TEST

25. Classify burns by degree according to their symptoms. Write a "1" in the blanks before symptoms of first-degree burns, a "2" before symptoms of second-degree burns, and a "3" in the blanks before symptoms of third-degree burns.

______a. Damage extending into first layer of tissue

______b. Less pain because of nerve destruction

______c. Rapid healing

______d. Blistering

______e. Charred or white appearance of burned area

______f. Mild swelling and pain

______g. Considerable swelling

______h. Pain greater than that caused by first-degree burn

______i. Deep tissue destruction

______j. Wet appearance of burned area due to loss of plasma

______k. Redness or discoloration

______l. Mottled or red areas

26. State guidelines for administering first aid to a victim with an eye injury.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

e. ____

____

TEST

27. Discuss signs and symptoms of fractures.

28. State six guidelines for administering first aid to a victim with a suspected fracture.

a.

b.

c.

d.

e.

f.

(NOTE: Test item 29 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

29. Demonstrate the ability to

a. Properly lift a heavy object.

b. Perform first-aid treatment for simulated accident victims.

SAFETY AND BASIC FIRST AID
UNIT V

ANSWERS TO TEST

1. a. 2
   b. 2
   c. 3
   d. 1
   e. 3
   f. 2
   g. 1
   h. 3
   i. 2
   j. 2
   k. 1
   l. 2

2. Answer should include any two of the following.

   a. You have a responsibility to yourself to think before you act and to stay alert and aware of where you are in order to prevent personal injury
   b. You have a responsibility to your family members to continue providing for them and to keep them safe
   c. You have a responsibility to your fellow workers to prevent accidents to them by being concerned with their safety and welfare and by encouraging them to be safety conscious
   d. You have a responsibility to your employers to prevent accidents so that they are not shorthanded, their job progress is not slowed down or stopped, and their insurance rates are not increased, making them less competitive

3. Answer should include any three of the following.

   a. Causes worker to be tardy or absent
   b. Causes worker to neglect duty and be less productive
   c. May cause worker to lose job
   d. Creates a safety hazard to worker and to fellow workers
   e. Drives up cost of production and cost of insurance, making employer less competitive

4. **General safety** (Answer should include any three of the following.)

   a. Be familiar with location of fire-fighting and first-aid equipment
   b. Be alert and conduct yourself in a manner that will ensure safe practices
   c. Be conscious of others' safety and encourage others to do the same
   d. Report all accidents, regardless of nature or severity, to the supervisor
   e. Be aware of OSHA, NIOSH, MSHA, and job-project safety rules
   f. Be certain ample ventilation is provided in areas where carbon monoxide may be present

   Personal safety (Answer should include any four of the following.)

   a. Remove rings and other jewelry when working
   b. Confine long hair before operating power equipment
   c. Wear close-fitting clothing appropriate for activity being performed
   d. Wear safety shoes, proper boots, and gloves
   e. Wear face and eye protection as required
   f. Wear ear protection as required

ANSWERS TO TEST

g. Wear respiratory protection approved for the contaminant you will be exposed to
h. Protect exposed skin
i. *Never* use compressed air to clean clothes or person
j. *Do not* carry sharp tools in your pockets
k. Encourage and enforce personal hygiene

Equipment and tool safety (Answer should include any three of the following.)

a. Obey all safety rules, and observe limitations on equipment according to specifications and manufacturer's requirements
b. Maintain all tools in a safe working order, and properly store tools when not in use
c. Retain guards and safety devices on all equipment
d. Tag and report to the supervisor any defective tools, machines, or other equipment
e. Be sure to shut off all power equipment when finished with it, and *do not* leave equipment until it has stopped completely
f. Operate equipment only after receiving instructions on how to operate it safely
g. Disconnect power from equipment before changing accessories and before performing service or maintenance on it
h. Use the correct tool for the job for which it was intended
i. Clean chips from grinders and other equipment with a brush; *do not* clean equipment with your hands or with a rag; *do not* clean equipment while it is running

Work-area safety (Answer should include any three of the following.)

a. Arrange equipment to permit safe, efficient work practices and ease of cleaning
b. Store materials and supplies safely in their proper places
c. Store tools and accessories safely in cabinets, on racks, or in suitable storage areas
d. Keep work area clear of debris and other hazards
e. Always remove nails from wood prior to storage or disposal
f. Clean floors of obstructions and slippery substances; clean up spills immediately
g. Keep aisles, exits, and traffic areas free of materials and debris
h. Dispose of combustible materials properly
i. Keep sufficient brooms, brushes, waste containers, and other housekeeping equipment readily available

Flammable-liquid safety (Answer should include any three of the following.)

a. Carefully read labels on all flammable liquids, and use flammable liquids only in open, well-ventilated areas
b. Be sure that all flammable liquids are marked correctly for storage
c. Store all flammable liquids properly and only in approved safety containers
d. When clothing is soaked by a flammable liquid, immediately change clothing and cleanse body with appropriate cleaner
e. Use flammable liquids only for their intended purposes
f. *Do not* use flammable liquids near fire or flame
g. Always be aware of location of appropriate fire extinguisher
h. Stop, drop, and roll to smother fire; *never* run

ANSWERS TO TEST

Gasoline-powered-equipment safety (Answer should include any three of the following.)

a. Use caution to prevent contact with hot manifolds and hoses
b. Be sure that equipment is out of gear before starting
c. Always keep appropriate fire extinguisher near when starting and operating gasoline-powered equipment
d. *Do not* pour gasoline into carburetor or cylinder head when starting engine; use recommended starting fluid
e. *Never* pour gasoline into fuel tank when engine is hot or when engine is running
f. *Do not* operate equipment that is leaking gasoline
g. Stop, drop, and roll to smother fire; *never* run

Materials-handling safety (Answer should include any three of the following.)

a. Avoid contact with the skin
b. Protect skin that is exposed
c. Wear protective clothing
d. Wear properly maintained, OSHA-approved safety equipment
e. Use good work practices to reduce dust in the air when handling cement and concrete
f. Be certain adequate ventilation is provided when using epoxy resins, organic solvents, and other toxic substances
g. *Never* use solvents to clean skin
h. Immediately remove epoxy, organic solvents, and other toxic substances from skin; use appropriate cleansing agents to remove these substances

5. Answer should include any four of the following.

a. Maintain OSHA regulations
b. Use only approved scaffolding
c. Inspect scaffolds regularly
d. Install all braces and accessories according to manufacturer's recommendations
e. Install anchors and guy wires on freestanding scaffolds as required
f. Keep scaffolds plumb and level
g. *Do not* overload scaffolds
h. Be sure all safety rails are installed according to OSHA regulations
i. Be sure wheels are locked before ascending rolling scaffolds
j. Always check for electrical wires and disengage wires before erecting metal scaffolds in the vicinity
k. *Do not* work on scaffolds during storms or high winds, or when scaffolds are covered with ice or snow

6. Answer should include any four of the following.

a. Fully spread and lock stepladders before using
b. *Do not* use ladders that are *not* equipped with safety shoes
c. *Never* overreach from a ladder

ANSWERS TO TEST

d. *Never* work from the top step of a ladder
e. *Never* use ladders in horizontal position
f. *Do not* climb a ladder that is occupied by someone else
g. *Never* use a metal ladder when there is any possibility of contact with electrical wires or conductors
h. Place ladders with approximately one-quarter of their support length away from vertical plane of top support, and extend ladders at least 3 feet above top support
i. Secure ladders at top and bottom to prevent displacement; brace long ladders at intermediate points to prevent spring
j. Remove ladder when you are finished using it, and always remove and store ladder at end of workday

7. a. 4
b. 3
c. 7
d. 6
e. 1
f. 2
g. 5
h. 1

8. a. 2
b. 1
c. 3
d. 4

9. a. 2
b. 1
c. 3
d. 3
e. 1
f. 2
g. 3
h. 1

10. Answer should include any eight of the following.

a. Asbestos
b. Acetone
c. Arsenic
d. Benzene
e. Cadmium
f. Chromates
g. Cobalt
h. Coal dust
i. Coal-tar pitch
j. Chlorine
k. Carbon tetrachloride
l. Carbon monoxide
m. DDT
n. Epoxies
o. Fiberglass
p. Hydrochloric acid
q. Lead compounds
r. Nickel compounds
s. Ozone
t. Petroleum oils
u. Plastic film and polyurethane foam
v. Sulfuric acid

11. a. Solids
b. Liquids
c. Vapors, mists, fumes, and gases

ANSWERS TO TEST

12. Answer should include any three of the following.

    a. Inhaled
    b. Absorbed through the skin
    c. Ingested while eating and drinking
    d. Contracted through open cuts and sores

13. a. Substance comes in direct contact with an area of the body and affects only that area
    b. Substance is absorbed by one area of the body but spreads throughout the body and may affect other body systems

14. Discussion should include the following.

    a. Mild irritation
    b. Severe damage to any or all of the body's systems
    c. Terminal conditions or diseases

15. a. 2
    b. 3
    c. 1
    d. 2
    e. 3
    f. 3
    g. 1

16. Answer should include any two of the following.

    a. May mean the difference between life and death
    b. May mean the difference between temporary and permanent disability
    c. May mean the difference between rapid recovery and long hospitalization
    d. Prepares one for what to do and what *not* to do in an emergency
    e. Promotes safety awareness

17. Answer should include any three of the following.

    a. Frostbite
    b. Bleeding
    c. Burns
    d. Loss of consciousness
    e. Respiratory failure/cardiac arrest
    f. Eye injury
    g. Muscle and ligament strain or sprain
    h. Broken bones
    i. Poisoning

18. a. 3
    b. 2
    c. 1
    d. 6
    e. 4
    f. 5
    g. 8
    h. 7

ANSWERS TO TEST

19. Description should include the following.

Early stages

a. Pale or bluish skin that is cold to the touch
b. Moist, clammy skin if perspiration has occurred
c. Weakness
d. Rapid pulse (over 100 beats per minute), often too faint to be felt in wrist but perceptible in carotid artery at the side of neck or femoral artery at groin
e. Increased rate of breathing that may be either shallow or deep and irregular
f. Restlessness, anxiousness, severe thirst if victim is in shock from hemorrhage
g. Vomiting or nausea

Late stages

a. Apathy and relative lack of responsiveness
b. Sunken eyes with vacant expression and widely dilated pupils
c. Mottled appearance of skin, indicating that victim's blood pressure has fallen to a very low level
d. Loss of consciousness, low body temperature, and death if untreated

20. Answer should include any four of the following.

a. Drink plenty of fluids
b. *Do not* overexert
c. Wear lightweight clothing that allows sweat to evaporate
d. Keep head covered and face shaded
e. Take frequent short work breaks
f. Rest in the shade or in an air-conditioned room whenever possible

21. a

22. Answer should include any four of the following.

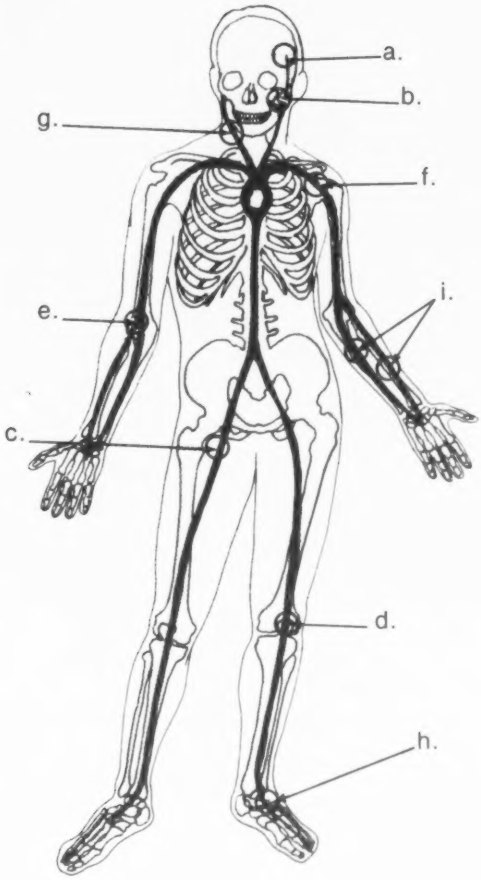
a. Wear protective cold-weather clothing
b. Wear several layers of light clothing rather than one layer of heavy clothing
c. Take break periods in a warm place
d. Drink warm beverages
e. Try to keep from sweating
f. *Do not* get clothes wet

23. Description should include the following.

a. Skin will turn white or grayish
b. Skin surface will be hard, but underlying tissue will be soft
c. With deeper involvement, large blisters will appear on skin surface as well as on underlying tissue, and affected area is hard, cold, and insensitive (numb)

ANSWERS TO TEST

24.



25.
a. 2
b. 3
c. 1
d. 2
e. 3
f. 1
g. 2
h. 2
i. 3
j. 2
k. 1
l. 2

26.
a. *Do not* let victim rub the eye
b. *Do not* attempt to remove a foreign object by using any sharp object
c. Keep victim flat on back if injury is caused by a penetrating object or a severe blow; *do not* wash out eye with water; *do not* try to remove object penetrating the eye
d. Cover eye with a clean dressing if foreign object is lodged in eye and cannot be removed easily by flushing with water or by using a clean cloth
e. Immediately flood with water any chemical substances in eye

ANSWERS TO TEST

27. Discussion should include the following.

    a. Victim's account of accident
    b. Differences in shape and length of corresponding bones on the two sides of body
    c. Obvious deformities
    d. Swelling
    e. Discoloration
    f. Pain or tenderness to touch
    g. Hemorrhage

28. Answer should include any six of the following.

    a. Prevent motion of injured parts and adjacent joints
    b. When an injured person obviously requires hospitalization and an ambulance is on the way, *do not* attempt to move the victim unless there is a life-threatening emergency
    c. Give priority to open fractures over closed fractures unless associated injuries dictate otherwise
    d. *Never* test for fracture by having the victim move the possibly broken part or try to walk on a possibly broken leg
    e. *Never* attempt to set or reduce a fracture or try to push a protruding bone end back in place
    f. If possible, take time to tie victim's injured leg to the uninjured one, or to bind injured arm to chest or side
    g. *Do not* allow victim to move the head (and *do not* move it yourself) when there is a possible neck or spine fracture
    h. Lift and move an unconscious victim as though the injury is to the neck or spine—provide rigid support for victim's back and head
    i. After providing urgent care, treat to prevent traumatic shock

29. Performance skills evaluated to the satisfaction of the instructor

BASIC MATH
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to solve basic math problems. The student will show this ability by completing unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with basic math.
2. Match to their correct names symbols used in math problems.
3. Label the place values of a whole number.
4. Add whole numbers.
5. Subtract whole numbers.
6. Multiply whole numbers.
7. Divide whole numbers.
8. Distinguish among types of fractions.
9. Reduce fractions to lowest terms.
10. Convert mixed numbers to improper fractions.
11. Convert improper fractions to mixed numbers.
12. Add fractions.
13. Subtract fractions.
14. Multiply fractions.
15. Divide fractions.
16. Label the place values of a decimal number.
17. Add decimal numbers.
18. Subtract decimal numbers.

OBJECTIVE SHEET

19. Multiply decimal numbers.
20. Divide decimal numbers.
21. Convert fractions to decimal numbers and percentages.
22. Identify decimal and fractional equivalents.
23. Convert percentages to fractions and decimal numbers.
24. Solve percentage problems.
25. Match terms used in geometry to their correct definitions.
26. Match types of geometric figures to their correct descriptions.
27. Match units of measure to their correct equivalents.
28. Calculate area of geometric figures.
29. Calculate volume of solid figures.
30. Solve basic ratio and proportion problems.

BASIC MATH
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

    A. Objective sheet

    B. Suggested activities

        1. Supplements

            a. Supplement #1 — Crossword Puzzle of Basic Math Terms

            b. Supplement #2 — Subtraction Squares

            c. Supplement #3 — Geometry Terms Word Search

        2. Answers to supplements

    C. Transparency masters

        1. TM #1 — Area of a Parallelogram

        2. TM #2 — Area of a Circle

        3. TM #3 — Ratio and Proportion

    D. Information sheet

    E. Assignment sheets

        1. Assignment Sheet #1 — Add Whole Numbers

        2. Assignment Sheet #2 — Subtract Whole Numbers

        3. Assignment Sheet #3 — Multiply Whole Numbers

        4. Assignment Sheet #4 — Divide Whole Numbers

        5. Assignment Sheet #5 — Work with Fractions

        6. Assignment Sheet #6 — Reduce Fractions to Lowest Terms

        7. Assignment Sheet #7 — Convert Unlike Fractions to Like Fractions

        8. Assignment Sheet #8 — Convert Fractions and Mixed Numbers

        9. Assignment Sheet #9 — Add Fractions

SUGGESTED ACTIVITIES

10. Assignment Sheet #10 — Subtract Fractions
11. Assignment Sheet #11 — Multiply Fractions
12. Assignment Sheet #12 — Divide Fractions
13. Assignment Sheet #13 — Add Decimal Numbers
14. Assignment Sheet #14 — Subtract Decimal Numbers
15. Assignment Sheet #15 — Multiply Decimal Numbers
16. Assignment Sheet #16 — Divide Decimal Numbers
17. Assignment Sheet #17 — Convert Fractions and Percentages
18. Assignment Sheet #18 — Solve Percentage Problems
19. Assignment Sheet #19 — Calculate Area
20. Assignment Sheet #20 — Calculate Volume
21. Assignment Sheet #21 — Estimate Cubic Yards
22. Assignment Sheet #22 — Solve Basic Ratio and Proportion Problems

F. Answers to assignment sheets

G. Test

H. Answers to test

II. Instructor's guide

A. Obtain materials to supplement unit.

1. Films
2. Books

a. *Speaking of Numbers*. This self-instructional workbook/textbook series is intended for use with two groups of students: (1) beginning English-as-a-second-language students, who are concurrently studying English and basic mathematic skills; and (2) native speakers of English who require remediation and reinforcement in numbers and arithmetic operations.

(NOTE: *Speaking of Numbers* is available from the Institute of Modern Languages, 2622 Pittman Drive, Silver Spring, Maryland 20910.)

SUGGESTED ACTIVITIES

        b. *Math*. This book is part of a series of manuals developed specifically for special-needs programs for disadvantaged and handicapped students. Seven areas of instruction have assignment sheets specifically designed to acquaint students with basic and practical mathematical problems and terms directly related to vocational skill trades. The guide contains instruction in measurement, whole numbers, fractions, decimals, percentages, consumer education, and geometry.

        (NOTE: *Math* is available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.)

    3. Transparencies and competency profiles

    (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006. Phone [202] 393-2040.)

B. Make additional transparencies and additional copies of assignment sheets and supplements if needed.

C. Use the assignment sheets (or parts of them) to pretest students in each math concept. Those students who demonstrate proficiency and an understanding of the concept may use the assignment sheets as a review or may be paired with those students who need help in mastering the concepts.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives.

    1. Introduce unit by discussing the technological explosion presently underway in the world and its effects on our lives. Emphasize the increased demand for technical skills.

    2. Point out that an understanding of mathematical concepts, a grasp of analytical logic, accuracy in computational skills, and the ability to apply these skills to a wide variety of situations are essential to getting and keeping a job.

SUGGESTED ACTIVITIES

F. Provide students with information and assignment sheets.

G. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss terms associated with basic math.

   SUGGESTIONS:

   - Point out the importance of defining terms for common understanding.
   - Have students complete Supplement #1 as a review of terms.

2. Use Information Sheet, Section II, to discuss symbols used in math problems.

   SUGGESTIONS:

   - Prepare examples of problems using the symbols.
   - Have students discuss where they have seen the math symbols used.

3. Use Information Sheet, Sections III and IV, and Assignment Sheet #1 to discuss place values of whole numbers and addition.

   SUGGESTIONS:

   - Play "You Inherit" with the students to help them learn place values. Ask students to tell you the least amount they inherit when you give them the amount in numbers of digits.

     EXAMPLE: Q. You have just inherited a six-digit sum. What is the least amount you inherit?
     A. One hundred thousand dollars

   - Prepare groups of objects such as bottle caps, books, tacks, nails, boards, and crayons to be added at different tables. Have students stop at each table and perform the addition as directed. Provide each student with a work sheet on which the equation and answer could be written.

     (NOTE: Similar situations could be set up for subtraction.)

   - Have students play dominoes. Score ends in multiples of five and play to 250, or score ends at end of each turn and play to 1000 points.

SUGGESTED ACTIVITIES

4. Use Information Sheet, Section V, and Assignment Sheet #2 to discuss subtraction.

   SUGGESTIONS:

   - Develop a set of flash cards containing various subtraction problems. Show students each card and have them give you the correct answer, either orally or written on a sheet of paper.
   - Use spinner and game boards. Each student spins twice, writes down each number, subtracts the difference, and moves the marker the appropriate number of jumps.
   - Have students practice subtraction by completing Supplement #2.

     (NOTE: You may want to prepare similar squares for addition, multiplication, and division with whole numbers, fractions, or decimals; or for calculations with exponents and square roots of the perfect square.)

5. Use Information Sheet, Section VI, and Assignment Sheet #3 to discuss multiplication.

   SUGGESTIONS:

   - Obtain or make multiplication table to 12. Have students learn the table.
   - Sit students in a circle. Have all students clap hands twice on legs, then clap hands together twice, then snap fingers twice to establish a rhythm that is to continue unbroken throughout the game. The caller gives a multiplication (or other operation) problem such as 8 × 6 while snapping fingers, and at the next finger snapping, says the name of someone to answer the problem. The responder gives answer at next finger snapping without breaking the clap/snap rhythm. If the responder maintains the rhythm and gives the correct answer, then he or she becomes the next caller. If the responder breaks the rhythm or gives an incorrect answer, then he or she is out of the game. The last person left is the winner.

6. Use Information Sheet, Section VII, and Assignment Sheet #4 to discuss division.

   SUGGESTION:

   - For students who consistently cannot make the appropriate decisions to solve long-division exercises, try the decision-free, step-by-step procedure on the next page.

SUGGESTED ACTIVITIES

a. Copy the problem.

b. Draw a vertical line to the right of the problem.

c. Make a guess and write that down to the right of the vertical line.

d. Multiply the guess by the divisor and subtract from the original number.

e. Repeat the process until subtracting produces a number smaller than divisor.

52)86310	
52000	1000
34310	
20800	400
13510	
10400	200
3110	
2600	50
510	
416	8
94	
52	1
42	1659

f. The answer is the sum of the guesses.

g. Check by multiplying the answer times the divisor and adding the remainder. If the problem has been solved correctly, the resulting sum should equal the original number inside the division frame.

EXAMPLE:		
	1659	Answer
	× 52	Divisor
	3318	
	8295	
	86268	
	+ 42	Remainder
	86310	Sum Equal to Original Number

7. Use Information Sheet, Section VIII, and Assignment Sheet #5 to discuss types of fractions.

SUGGESTIONS:

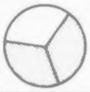
- Write a proper fraction, such as 3/8, on the chalkboard. Label the fraction's nominator and denominator. Explain that the denominator of this (or any) fraction represents the way the unit has been split. Illustrate this point by drawing on the chalkboard a circle split into eight parts. Now explain that the numerator of this (or any) fraction represents the number of parts involved in the calculation. Therefore the fraction 3/8 indicates three parts of something that has been divided into eight parts. Shade in three of the eight parts of the circle to illustrate this point.

SUGGESTED ACTIVITIES

- Make two decks of cards. Show fractions on one deck and the corresponding pictures on the other deck.

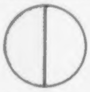
  EXAMPLE:

  2/3

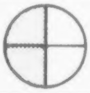


Cards can also be made to show equivalent fractions, using pictures and fractions.

EXAMPLE:



1/2



2/4

Students may play a game of matching or rummy by making pairs that match.

8. Use Information Sheet, Section IX, and Assignment Sheets #6 and #7 to discuss reducing fractions to the lowest terms and converting unlike fractions to like fractions.

   SUGGESTIONS:

   - Prepare twenty-four tagboard flash cards. On each card, write two or three unlike fractions.

     EXAMPLES:

     1/2 3/8 3/4

     3/5 2/3 1/6

     Laminate the cards. Have students number their papers from 1 to 24; then give them fifteen seconds to write the least common denominator for the fractions on each flash card shown. To increase the difficulty, shorten the time-span for calculating each lowest common denominator.

   - Use these flash cards to review addition, subtraction, and multiplication of fractions.

SUGGESTED ACTIVITIES

9. Use Information Sheet, Sections X and XI, and Assignment Sheet #8 to discuss converting mixed numbers to improper fractions and converting improper fractions to mixed numbers.

   SUGGESTION:

   - Have students practice measuring with rulers by measuring various items in the classroom: length of books, length and width of desk or table, height of chairs, length of pencil, and so on. Have students record their measurements on a sheet of paper, and then have them convert their measurements into improper fractions. After they have the improper fractions, have them give their lists to another student who then converts the improper fractions to mixed numbers.

10. Use Information Sheet, Section XII, and Assignment Sheet #9 to discuss adding fractions.

11. Use Information Sheet, Section XIII, and Assignment Sheet #10 to discuss subtracting fractions.

12. Use Information Sheet, Section XIV, and Assignment Sheet #11 to discuss multiplying fractions.

13. Use Information Sheet, Section XV, and Assignment Sheet #12 to discuss dividing fractions.

    SUGGESTION:

    - Point out that dividing fractions is just like multiplying fractions—except for the inversion step.

14. Use Information Sheet, Section XVI, to discuss the place values of decimals.

    SUGGESTION:

    - Have students write down several decimal numbers. Have students write out the decimal number by place values, i.e., tenths, hundredths, thousandths, ten thousandths, millionths.

15. Use Information Sheet, Section XVII, and Assignment Sheet #13 to discuss adding decimal numbers.

    SUGGESTION:

    - Assign a monetary value to each letter of the alphabet: A = \$0.50, B = \$1.00, C = \$1.50 . . . Z = \$13.00. Then have students calculate such problems as who has the most valuable name? What concrete masonry hand tool has the most valuable name? What concrete masonry power tool has the most valuable name?

      (NOTE: This activity can be adapted and used to practice multiplication of whole numbers, or for practice with fractions.)

16. Use Information Sheet, Section XVIII, and Assignment Sheet #14 to discuss subtracting decimal numbers. Emphasize the importance of checking answers.

17. Use Information Sheet, Section XIX, and Assignment Sheet #15 to discuss multiplying decimal numbers.

SUGGESTED ACTIVITIES

SUGGESTION:

- Increase student speed in certain multiplication problems by giving timed tests in which the student must use the following shortcuts.

  To multiply by

  5, 50, 500, etc., just multiply by 10, 100, 1000, etc., and divide by 2;

  25, 250, 2500, etc., just multiply by 100, 1000, etc., and divide by 4;

  $33\frac{1}{3}$, $16\frac{2}{3}$, $12\frac{1}{2}$, $8\frac{1}{3}$, $6\frac{1}{4}$ multiply by 100 and divide by 3, 6, 8, 12, 16, respectively.

18. Use Information Sheet, Section XX, and Assignment Sheet #16 to discuss dividing decimal numbers.

SUGGESTION:

- Increase student speed in certain division problems by giving timed tests in which students use the following shortcuts.

  To divide by

  $3\frac{1}{3}$, multiply by 3 and divide by 10;

  $33\frac{1}{3}$, multiply by 3 and divide by 100;

  $16\frac{2}{3}$, multiply by 6 and divide by 100;

  25, multiply by 4 and divide by 100;

  50, multiply by 2 and divide by 100.

(NOTE: There are other shortcuts that you may want to add to this list of multiplication of shortcuts.)

19. Use Information Sheet, Sections XXI through XXIV, and Assignment Sheets #17 and #18 to discuss fractional equivalents and the conversion of fractions and decimals.

SUGGESTIONS:

- Before presenting rules for converting fractions to decimals, have students solve problems by converting the decimals to fractions. The answer from the computation with the equivalent fractions must then be converted back to a decimal form. A half dozen exercises like this for each decimal rule may help students appreciate the benefits of learning the rules and why the decimal rules work.

SUGGESTED ACTIVITIES

EXAMPLE: $5.67 + 3.2 + 4.104 = 5\frac{670}{1000} + 3\frac{200}{1000} + 4\frac{104}{1000}$

$$= 12\frac{974}{1000}$$

$$= 12.974$$

- Obtain a set of twist drills and a drill index. Take the drills out of the drill index. Have students replace drills in the index, noting the decimal and fractional differences in the drill sizes.
- Obtain a quantity of pocket-sized decimal equivalent charts from your local tool supplier. Give one to each student.
- Illustrate percentages by providing students with graph or grid paper. Have students outline at least eight 10-by-10-block squares. Since each block contains 100 units or small squares, students can shade in enough units to illustrate 25 percent, 33⅓ percent, 50 percent, 96 percent, and so on.

20. Use Information Sheet, Section XXV, to discuss terms used in geometry.

SUGGESTION:

- Have students review the terms by completing Supplement #3.

21. Use Information Sheet, Section XXVI, to discuss types of geometric figures.

SUGGESTIONS:

- Develop a bulletin board display showing types of geometric figures.
- Prepare poster-board cutouts of each geometric figure. As you discuss each figure, attach the cutout to the chalkboard (with masking tape on back) or attach the cutout to a clothesline. When discussion is completed, students will be able to observe the differences among the types of geometric figures.

22. Use Information Sheet, Section XXVII, to discuss common units of measure and their equivalents.

SUGGESTIONS:

- Have students practice measuring with a tape measure. Use various lengths of lumber. Have students measure width, thickness, and length of each piece and write their answers on a sheet of paper. As additional practice, you could have students convert all fractions to decimals.

SUGGESTED ACTIVITIES

- Illustrate the length of a rod by measuring and marking a 16 1/2-foot line on your classroom floor.

23. Use Information Sheet, Section XXVIII, and Assignment Sheet #19 to discuss formulas for calculating areas of geometric figures.

    SUGGESTIONS:

    - Use Transparencies #1 and #2 to illustrate formulas for figuring the area of a square, a rectangle, or a circle.
    - Floor plans of buildings can be a source for a variety of mathematical problems. Sample floor plans may be obtained from blueprints of homes, newspapers, or perhaps from old real-estate-agency listings. Some students may prefer to design their own floor plans. Provide students with a floor plan and have them calculate the total square feet in the building and the square feet for each room.

24. Use Information Sheet, Section XXIX, and Assignment Sheets #20 and #21 to discuss calculating the volume of solid figures.

    SUGGESTION:

    - Visit a construction site before concrete is to be poured. Have students measure forms and determine the volume of concrete that will be needed. You may want to have the students determine the total cost of the concrete, also.

25. Use Information Sheet, Section XXX, and Assignment Sheet #22 to discuss ratio and proportion.

    SUGGESTION:

    - Use Transparency #3 to illustrate ratio and proportion.

H. Give test.

(NOTE: It is recommended that this test be given in parts, such as the math processes, fractions, and decimals.)

I. Critique test and discuss in class.

J. Reteach if necessary.

K. Complete appropriate section of competency profiles.

SUGGESTED ACTIVITIES

III. Unit references

A. Gossage, Loyce G., and Milton Briggs. *Basic Mathematics Review.* Cincinnati, Ohio: South-Western Publishing Co., 1969.

B. Hendrix, Laborn J. "Bud." *Bricklaying Curriculum: Basic Core.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1983.

C. Hendrix, Laborn J. "Bud." *Heavy Equipment Operator Instructional Materials, Volume I.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1981.

D. *Math One.* Oklahoma City, Oklahoma: Oklahoma Department of Transportation, 1970.

E. Morrison, Phyllis. *Basic Math Skills.* New York: McGraw-Hill Book Company, 1972.

F. Turcotte, Raymond J. *Bricklaying Curriculum Instructional Units.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1977.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — CROSSWORD PUZZLE OF BASIC MATH TERMS

NAME ________________________________ SCORE ______________

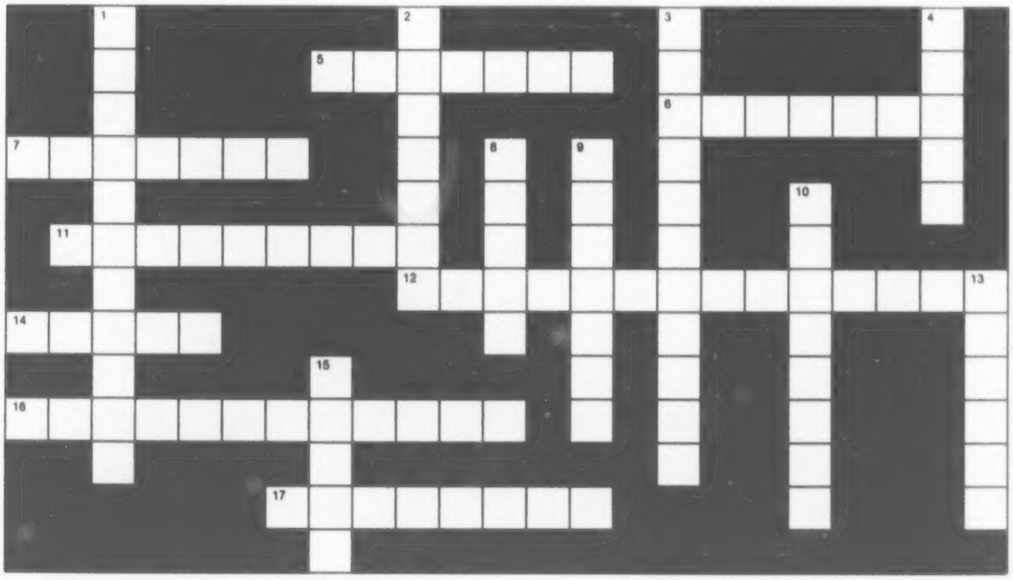
To help you review the terms used in this unit, use the clues below to complete the following crossword puzzle.

ACROSS

5. One part in a hundred; reckoned on the basis of a whole divided into one hundred parts
6. Pertaining to nominal units based on a 4-inch module
7. Any of the natural numbers; the whole numbers, positive and negative
11. To solve by mathematical process
12. Abbreviated process of adding a number to itself a specified number of times
14. Relationship in quantity, amount, or size between two or more things
16. Being relatively equal in size or quantity
17. Opposite (inverse) operation of multiplication

DOWN

1. Opposite (inverse) operation of addition
2. Mathematical proposition
3. Theoretical size that may vary from the actual (2 wds.)
4. Inverted "V" symbol used to indicate where something is to be inserted
8. With 13 Down, any of the integers that represents a complete item
9. Fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the numerator
10. Part of a whole; represents one or more equal parts of a unit
13. See 8 Down
15. Any one of the ten symbols, 0 to 9, by which all numbers can be expressed



SUGGESTED ACTIVITIES

SUPPLEMENT #2 — SUBTRACTION SQUARES

Cut out the sixteen squares shown below and then fit them together so that the edges that touch form a problem and its correct solution. For better durability, glue the sheet to heavy poster board before cutting out squares.

10−5 6 9−1 8−1	8 10−7 15−5 12−2	9−4 5	11−2 2
6 6−2 12−6 10−2	7 10 6−4 9−6	4−0 7	0 12−3
7−4 2 4	3 10−6 9−2	10 8−3 4	4 3 5
9 8 3	1 8−8 5	9 7−6 9−3	8−6 4 7−3

SUGGESTED ACTIVITIES

SUPPLEMENT #3 — GEOMETRY TERMS WORD SEARCH

The following geometry terms are hidden in the puzzle below. Find and circle each term. Words may be spelled forward, backward, from top to bottom, or diagonally. A score of 8 is good, 10 is excellent, and 13 to 14 is super.

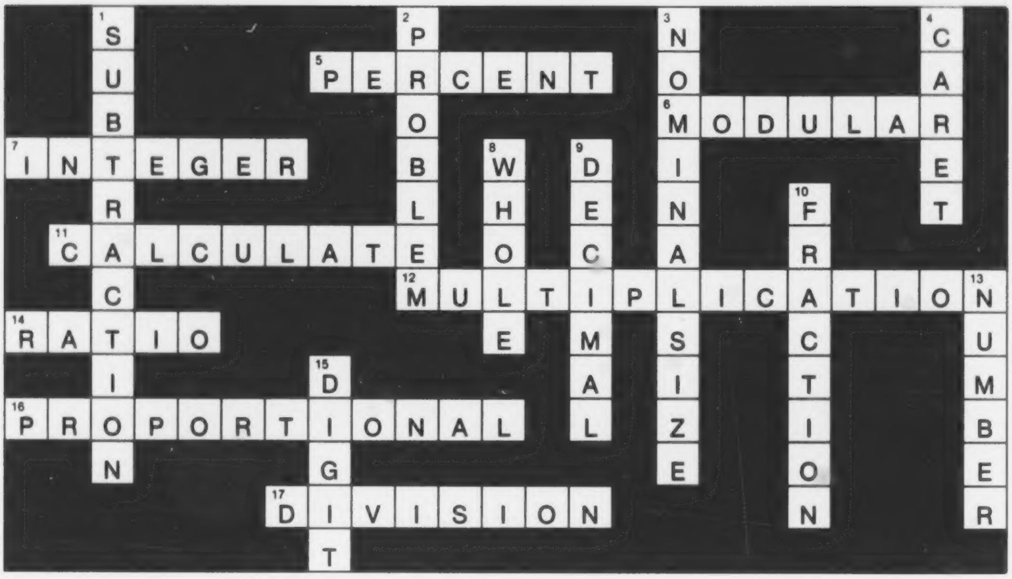
GEOMETRIC FIGURES
PERIMETER
LINEAL
PARALLEL
PERPENDICULAR
RIGHT ANGLE
RADIUS
DIAMETER
CIRCUMFERENCE
PI
AREA
VOLUME
CUBIC UNIT
CUBIC FOOT

G	B	F	P	E	R	I	M	E	T	E	R	R	D	C	L
K	E	N	Q	Y	S	Z	V	O	L	U	M	E	J	I	I
T	O	O	F	C	I	B	U	C	B	F	K	T	Z	R	N
D	N	M	M	K	W	N	V	C	B	H	I	E	L	C	E
U	B	M	J	E	G	J	K	P	I	N	F	M	M	U	A
G	K	R	C	H	T	L	A	D	U	D	L	A	B	M	L
X	S	U	I	D	A	R	Q	C	R	H	L	I	C	F	Q
C	G	R	M	G	A	G	I	H	S	T	S	D	R	E	M
F	C	G	J	L	E	B	L	C	K	G	M	P	B	R	R
G	K	N	L	V	U	C	B	W	F	T	M	S	R	E	D
R	S	E	D	C	D	B	C	F	T	I	L	J	N	N	P
B	L	D	T	R	I	G	H	T	A	N	G	L	E	C	T
P	G	X	C	W	M	D	S	N	W	H	C	U	Q	E	P
W	A	E	R	A	D	P	G	B	F	C	D	H	R	L	N
C	L	S	W	R	T	R	G	V	Y	M	B	H	B	E	W
P	E	R	P	E	N	D	I	C	U	L	A	R	X	C	S

SUGGESTED ACTIVITIES

ANSWERS TO SUPPLEMENTS

Supplement #1


1 SUBTRACTION
2 PROBLEM
3 NOMINAL SIZE
4 CARET
5 PERCENT
6 MODULAR
7 INTEGER
8 WHOLE
9 DECIMAL
10 FRACTION
11 CALCULATE
12 MULTIPLICATION
13 NUMBER
14 RATIO
15 DIGIT
16 PROPORTIONAL
17 DIVISION

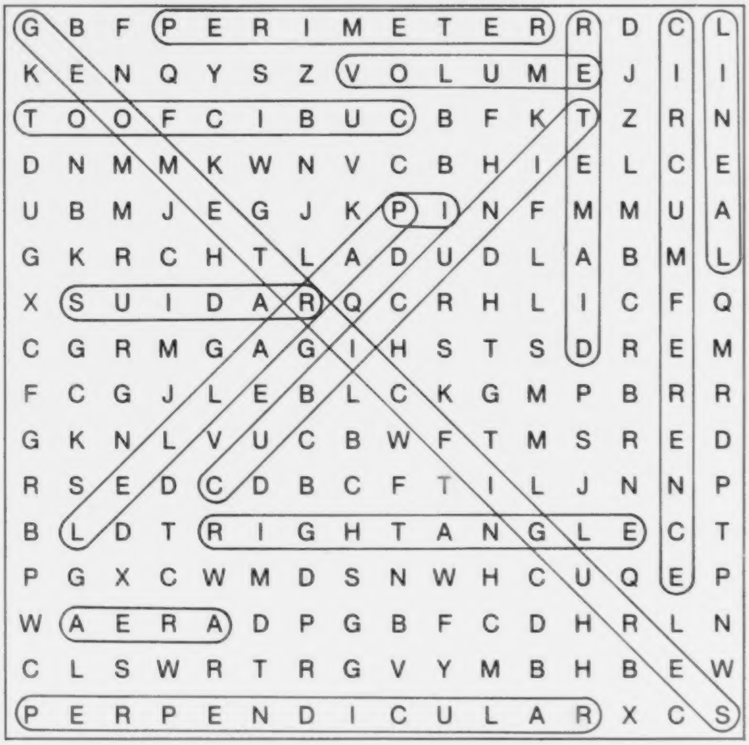
ANSWERS TO SUPPLEMENTS

Supplement #2

11−2 2	9 7−6 9−3	1 8−8 5	0 12−3
8−6 4 7−3	6 6−2 12−6 10−2	10−5 6 9−1 8−1	9 8 3
4 3 5	8 10−7 15−5 12−2	7 10 6−4 9−6	7−4 2 4
9−4 5	10 8−3 4	3 10−6 9−2	4−0 7

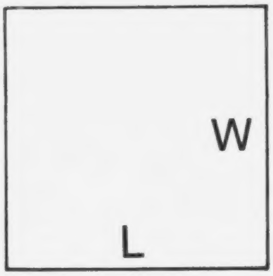
ANSWERS TO SUPPLEMENTS

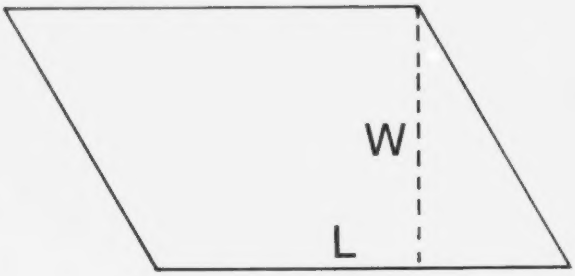
Supplement #3

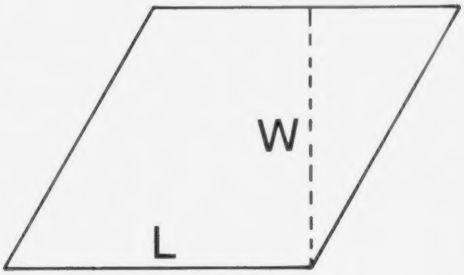


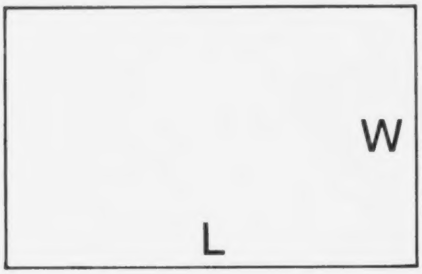
G	B	F	P	E	R	I	M	E	T	E	R	R	D	C	L
K	E	N	Q	Y	S	Z	V	O	L	U	M	E	J	I	I
T	O	O	F	C	I	B	U	C	B	F	K	T	Z	R	N
D	N	M	M	K	W	N	V	C	B	H	I	E	L	C	E
U	B	M	J	E	G	J	K	P	I	N	F	M	M	U	A
G	K	R	C	H	T	L	A	D	U	D	L	A	B	M	L
X	S	U	I	D	A	R	Q	C	R	H	L	I	C	F	Q
C	G	R	M	G	A	G	I	H	S	T	S	D	R	E	M
F	C	G	J	L	E	B	L	C	K	G	M	P	B	R	R
G	K	N	L	V	U	C	B	W	F	T	M	S	R	E	D
R	S	E	D	C	D	B	C	F	T	I	L	J	N	N	P
B	L	D	T	R	I	G	H	T	A	N	G	L	E	C	T
P	G	X	C	W	M	D	S	N	W	H	C	U	Q	E	P
W	A	E	R	A	D	P	G	B	F	C	D	H	R	L	N
C	L	S	W	R	T	R	G	V	Y	M	B	H	B	E	W
P	E	R	P	E	N	D	I	C	U	L	A	R	X	C	S

Area of a Parallelogram



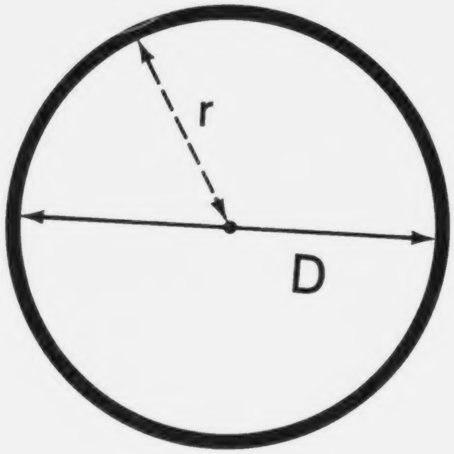






Area = Length (L) × Width (W)

Area of a Circle



Pi (π) = 3.1416

$$\text{Radius (r)} = \frac{\text{Diameter (D)}}{2}$$

$$\text{Area of Circle} = \pi r^2$$

Ratio and Proportion

1:1:3 = Ratio of Cement,
Lime, and Sand
in Mortar Mix

0.5:0.5:1.5 = Proportion of Ratio
1:1:3 Cut in Half

BASIC MATH
UNIT I

INFORMATION SHEET

I. Terms and definitions associated with basic math

A. Whole number (integer) — Any of the natural numbers, both positive and negative, that represents a complete item

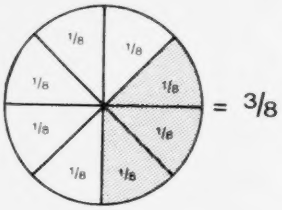
EXAMPLE: 25 is a whole number as opposed to $^{3}/_{4}$, a fraction or part of a whole.

B. Digit — Any one of the ten symbols, 0 to 9, by which all numbers can be expressed

C. Fraction — Part of a whole; represents one or more equal parts of a unit (Figure 1)

EXAMPLE:

FIGURE 1



D. Decimal — Fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the number

EXAMPLES: $0.1 = ^{1}/_{10}$
$0.06 = ^{6}/_{100}$
$0.003 = ^{3}/_{1000}$

E. Addition — Process of totaling two or more numbers to find another number called a *sum*

EXAMPLE: $3 + 5 + 9 = 17$

F. Subtraction — Opposite (inverse) operation of addition

EXAMPLE: $8 - 4 = 4$ as opposed to $4 + 4 = 8$

G. Multiplication — Abbreviated process of adding a number to itself a specified number of times

EXAMPLE: $6 \times 3 = 18$ as opposed to $6 + 6 + 6 = 18$

INFORMATION SHEET

H. Division — Opposite (inverse) operation of multiplication

EXAMPLE: 16 ÷ 2 = 8 as opposed to 8 × 2 = 16

I. Percent — One part in a hundred; reckoned on the basis of a whole divided into one hundred parts

J. Ratio — Relationship in quantity, amount, or size between two or more things

K. Proportional — Being relatively equal in size or quantity

EXAMPLE: 1:1:3 = 0.5:0.5:1.5

L. Nominal size — Theoretical size that may vary from the actual

EXAMPLE: A 2×4 stud is actually 1½ inches by 3½ inches.

M. Modular — Pertaining to nominal units based on a 4-inch module

N. Calculate — To solve by mathematical process

O. Problem — Mathematical proposition

II. Symbols used with math problems (Table 1)

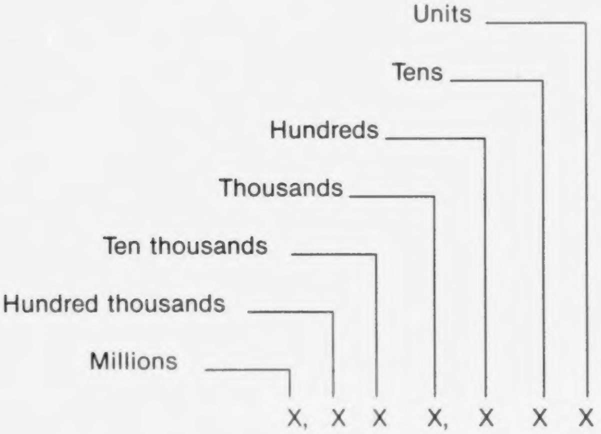
TABLE 1

Name of symbol	Symbol
Plus sign (addition)	+
Minus sign (subtraction)	−
Times sign (multiplication)	×
Division sign	÷
Division frame	$\overline{)\quad\quad}$
Equal sign	=
Decimal point	.
Percent symbol	%
Ratio symbol	:
Pi sign	π

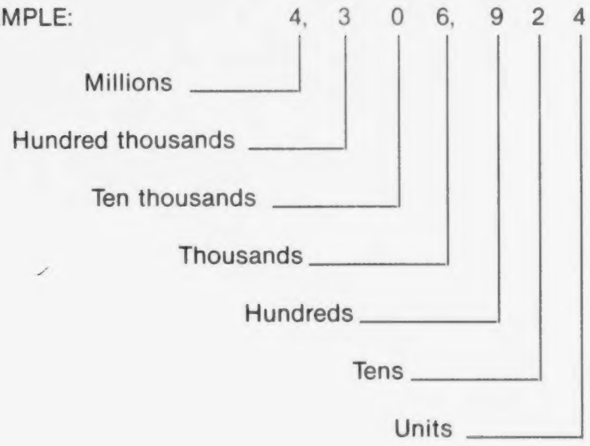
INFORMATION SHEET

III. Place values of a whole number

(NOTE: The position of a digit in a number shows how much that digit is worth. These positions are called *place values*.)


Units
Tens
Hundreds
Thousands
Ten thousands
Hundred thousands
Millions
X, X X X, X X X

EXAMPLE:


4, 3 0 6, 9 2 4
Millions
Hundred thousands
Ten thousands
Thousands
Hundreds
Tens
Units

(NOTE: The number in this example is four million, three hundred six thousand, nine hundred twenty-four.)

INFORMATION SHEET

IV. Adding whole numbers

A. Set up problem by writing units under units, tens under tens, and so on

EXAMPLE: Add the whole numbers 1632, 17, 550.

$$\begin{array}{r} 1632 \\ 17 \\ +\ 550 \\ \hline \end{array}$$

B. Add each column separately, beginning at top of units column

EXAMPLE:

$$\begin{array}{r} 1632 \\ 17 \\ +\ 550 \\ \hline 9 \end{array} \qquad \begin{array}{r} 1632 \\ 17 \\ +\ 550 \\ \hline 99 \end{array}$$

C. If the sum of any column is two or more digits, write the units digit in your answer and carry the remaining digit(s) to the top of next column to the left

EXAMPLE:

$$\begin{array}{rrrl} & & 1\leftarrow & \text{Carry remaining} \\ & 1632 & 1632 & \text{digit.} \\ & 17 & 17 & \\ \text{Write units} & +\ 550 & +\ 550 & \\ \cline{2-3} \text{digit.} & \rightarrow 199 & 199 & \end{array}$$

D. Add any carried digit(s) above the column with that column

EXAMPLE:

$$\begin{array}{rl} 1 & \text{Carried Digit} \\ 1632 & \\ 17 & \\ +\ 550 & \\ \hline 2199 & \end{array}$$

V. Subtracting whole numbers

A. Set up problem by writing units under units, tens under tens, and so on

(NOTE: The top number in the problem [original number] is almost always larger than the bottom number [subtracted number].)

EXAMPLE: Subtract 91 from 123.

$$\begin{array}{rl} 123 & \text{Original Number} \\ -\ 91 & \text{Subtracted Number} \\ \hline \end{array}$$

B. Subtract each column separately, beginning at bottom of units column

EXAMPLE:

$$\begin{array}{r} 123 \\ -\ 91\uparrow \\ \hline 2 \end{array}$$

INFORMATION SHEET

C. If a digit in the subtracted number is larger than the digit above it, "borrow" 1 from the top digit in the next column to the left, decreasing that digit by one and increasing the digit being subtracted from by ten

EXAMPLE:

$$\begin{array}{r} \overset{0}{\cancel{1}}\,2\,3 \\ -\quad 9\,1 \\ \hline 3\,2 \end{array}$$

D. If there is nothing to borrow in the next left column (column contains a zero), first borrow for that column from its next left column

EXAMPLE:

$$\begin{array}{r} \overset{8}{\cancel{9}}\,\overset{10}{\cancel{0}}\,6 \\ -\,3\,1\,8 \\ \hline \end{array} \qquad \begin{array}{r} \overset{8}{\cancel{9}}\,\overset{\overset{9}{\cancel{10}}}{\cancel{0}}\,6 \\ -\,3\,1\,8 \\ \hline 8 \end{array} \qquad \begin{array}{r} \overset{8}{\cancel{9}}\,\overset{\overset{9}{\cancel{10}}}{\cancel{0}}\,6 \\ -\,3\,1\,8 \\ \hline 8\,8 \end{array} \qquad \begin{array}{r} \overset{8}{\cancel{9}}\,\overset{\overset{9}{\cancel{10}}}{\cancel{0}}\,6 \\ -\,3\,1\,8 \\ \hline 5\,8\,8 \end{array}$$

E. Check your subtraction by adding your answer to the subtracted number

EXAMPLE:

	Problem		Check
271	Original Number	271	Original Number
−164	Subtracted Number	−164	
107	Answer	+ 107	
		271	Check Answer

(NOTE: If you have solved the problem correctly, your check answer should be the same as the original number.)

VI. Multiplying whole numbers

A. Set up problem by writing the larger number (original number) above the smaller number (multiplier), writing units under units, tens under tens, and so on

(NOTE: You will get the correct answer [product] no matter which number is placed above the other, but the faster method places the larger above the smaller.)

EXAMPLE: Multiply the numbers 53 and 4.

53	Original Number
× 4	Multiplier

INFORMATION SHEET

B. If the multiplier contains only one digit, multiply each digit in the original number by it, working from right to left

1. Multiply units digit in original number by multiplier

2. Write answer units digit and insert necessary carry digit above next left column in original number as required

EXAMPLE:

$$\begin{array}{r} 1 \\ 53 \\ \uparrow \\ \times\ \ 4 \\ \hline 2 \end{array}$$

3. Multiply tens digit by multiplier and add carried digit as required

EXAMPLE:

$$\begin{array}{r} 1 \\ 53 \\ \nwarrow \\ +\ \ 4 \\ \hline 212 \end{array}$$

C. If the multiplier contains more than one digit, find partial products

1. Multiply each digit in original number by each digit in multiplier, moving from right to left

2. Align partial products so that right-hand digit of each is directly under its corresponding digit in the multiplier

EXAMPLE: Multiply the numbers 174 and 42.

$$\begin{array}{rrrrrr} & 1 & 1 & 1 & 2\,1 & 2 \\ 174 & 174 & 174 & 174 & 174 & 174 \\ \uparrow & \nwarrow & \nwarrow & \nearrow & \uparrow & \nwarrow \\ \underline{\times\ \ 42} & \underline{\times\ \ 42} & \underline{\times\ \ 42} & \underline{\times\ \ 42} & \underline{\times\ \ 42} & \underline{\times\ \ 42} \\ 8 & 48 & 348 & 348 & 348 & 348 \\ & & & 6 & 96 & 696 \\ & & \uparrow & & & \uparrow \\ & & \text{First Partial} & & & \text{Second Partial} \\ & & \text{Product} & & & \text{Product} \end{array}$$

D. Add the partial products

EXAMPLE:

$$\begin{array}{r} 174 \\ \times\ 42 \\ \hline 348 \\ +\ 696 \\ \hline 7308 \end{array} \leftarrow \text{Answer (Product)}$$

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VII. Dividing whole numbers

A. Set up problem by writing original number (number to be divided) inside a division frame, and by writing divisor (number you are dividing by) outside frame

EXAMPLE: How many times will 33 go into 3347?

Divisor $33\,\overline{)3347}$ Original Number

B. Determine how many times the divisor will go into the first digit of the original number; if it will not, write a zero in the answer space directly above the first digit, and then determine how many times the divisor will go into the first two numbers of the original number

(NOTE: Continue trying to divide the original number by the divisor until a set of digits can be divided. Remember to write a zero each time the set of digits cannot be divided.)

EXAMPLE:

$$\begin{array}{r} 0 \\ 34\,\overline{)3347} \end{array}$$

34 goes into 3 zero times.

$$\begin{array}{r} 00 \\ 34\,\overline{)3347} \end{array}$$

34 goes into 33 zero times.

$$\begin{array}{r} 009 \\ 34\,\overline{)3347} \end{array}$$

34 goes into 334 nine times.

C. Multiply the divisor by the answer (digit above frame); write this answer under the digit(s) that divisor went into, and subtract

EXAMPLE:

$$\begin{array}{r} 34 \\ \underline{\times\ 9} \\ 306 \end{array}$$

Multiply divisor (34) by answer (9).

$$\begin{array}{r} 009 \\ 34\,\overline{)3347} \\ -\ \underline{306} \\ 28 \end{array}$$

Write answer under 334, the digits divisor went into, and subtract.

D. Bring down next unused digit from original number, and place it to the right of the subtracted difference (remainder)—even if the remainder is zero

EXAMPLE:

$$\begin{array}{r} 009 \\ 34\,\overline{)3347} \\ \underline{306\downarrow} \\ 287 \end{array}$$

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E. Determine how many times the divisor will go into this new number; write your answer in the answer space above the digit that was brought down

EXAMPLE:
$$\begin{array}{rl} & 0098 \\ 34 & \overline{)3347} \\ & \underline{306} \\ & 287 \end{array}$$

F. Multiply the divisor by the last digit you wrote in the answer; write this product under the digits that divisor went into, and subtract

EXAMPLE:
$$\begin{array}{r} 34 \\ \underline{\times\ 8} \\ 272 \end{array}$$
Multiply divisor (34) by last digit of answer (8).

$$\begin{array}{rl} & 0098 \\ 34 & \overline{)3347} \\ & \underline{306} \\ & 287 \\ & -\ \underline{272} \\ & 15 \end{array}$$
Write product under 287, the digits that divisor went into, and subtract.

G. Continue this process until all numbers in the original number are used

H. Write any remaining subtracted difference as a remainder

EXAMPLE:
$$\begin{array}{rl} & 0098 \\ 34 & \overline{)3347} \\ & \underline{306} \\ & 287 \\ & \underline{272} \\ & 15 \text{ Remainder} \end{array}$$

I. Check your answer by multiplying your answer times the divisor and adding the remainder to this number

(NOTE: If you have solved the problem correctly, your check answer should be the same as your original number.)

EXAMPLE:
$$\begin{array}{rl} 98 & \text{Answer} \\ \underline{\times 34} & \text{Divisor} \\ 392 & \\ \underline{294} & \\ 3332 & \\ \underline{+\ \ 15} & \text{Remainder} \\ 3347 & \text{Check Answer (Same as original number)} \end{array}$$

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VIII. Types of fractions

A. Proper — Top number of fraction (numerator) is smaller than bottom number of fraction (denominator)

EXAMPLE: $\frac{7}{8}$ Numerator / Denominator

B. Improper — Top number of fraction (numerator) is the same as or larger than bottom number of fraction (denominator)

EXAMPLES: $\frac{9}{8}$ $\frac{16}{16}$

C. Mixed numbers — Contains a whole number and a proper fraction

EXAMPLES: $9^1/_2$, $1^7/_8$, $4^3/_4$

IX. Reducing fractions to lowest terms — Divide the numerator and denominator by the largest whole number that will go into each evenly

EXAMPLE: Reduce $^4/_{16}$ to its lowest terms.

$$\frac{4}{16} = \frac{4 \div 4}{16 \div 4} = \frac{1}{4}$$

(NOTE: The fraction $^1/_4$ is reduced to its lowest term because the numerator [1] and the denominator [4] cannot be divided by the same number.)

X. Converting mixed numbers to improper fractions

A. Multiply the whole number by the denominator of the fraction

EXAMPLE: Convert $4^3/_8$ to an improper fraction.

$8 \times 4 = 32$

B. Add your answer to the numerator

EXAMPLE: $32 + 3 = 35$

C. Place this sum over the original denominator

EXAMPLE: $\frac{35}{8}$ Improper Fraction

INFORMATION SHEET

XI. Convert improper fractions to mixed numbers

A. Divide the numerator by the denominator

EXAMPLE: Convert $^{18}/_{15}$ to a mixed number.

$$\begin{array}{r} 01 \\ 15\overline{)18} \\ \underline{15} \\ 3 \text{ Remainder} \end{array}$$

B. Place the remainder over the denominator

EXAMPLE: $\dfrac{3 \text{ Remainder}}{15 \text{ Denominator}}$

C. Reduce this fraction if necessary

EXAMPLE: $\dfrac{3}{15} = \dfrac{3 \div 3}{15 \div 3} = \dfrac{1}{5}$

D. Add the reduced fraction to the whole number obtained by dividing the numerator by the denominator

EXAMPLE: $1 + \dfrac{1}{5} = 1\dfrac{1}{5}$ Mixed Number

XII. Adding fractions

A. Like fractions

(NOTE: Like fractions are those having the same, or common, denominators.)

EXAMPLES: $^1/_4$ and $^2/_4$, $^5/_8$ and $^5/_8$, $^1/_{16}$ and $^1/_{16}$

1. Add the numerators
2. Place sum of numerators over common denominator
3. Convert to mixed numbers and reduce as required

EXAMPLE 1: Add $^1/_4$ and $^2/_4$.

$$\frac{1}{4} + \frac{2}{4} = \frac{1+2}{4} = \frac{3}{4}$$

EXAMPLE 2: Add $^5/_8$ and $^5/_8$.

$$\frac{5}{8} + \frac{5}{8} = \frac{5+5}{8} = \frac{10}{8} = 10 \div 8 = 1\frac{2}{8} = 1\frac{1}{4}$$

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EXAMPLE 3: Add $^{1}/_{16}$ and $^{3}/_{16}$.

$$\frac{1}{16} + \frac{3}{16} = \frac{1+3}{16} = \frac{4}{16} = \frac{4 \div 4}{16 \div 4} = \frac{1}{4}$$

B. Unlike fractions

EXAMPLES: $^{11}/_{12}$ and $^{3}/_{9}$, $^{1}/_{8}$ and $^{3}/_{4}$

1. Change to like fractions

   a. Find the lowest number into which each denominator can be divided evenly (lowest common denominator)

   b. Multiply the numerators and denominators of each fraction by the number of times its denominator can be divided into the lowest common denominator

EXAMPLE 1: Add $^{11}/_{12}$ and $^{3}/_{9}$.

36 is lowest number into which both 12 and 9 can be divided evenly.

$36 \div 12 = 3$

$36 \div 9 = 4$

$$\frac{11}{12} = \frac{11 \times 3}{12 \times 3} = \frac{33}{36}$$

$$\frac{3}{9} = \frac{3 \times 4}{9 \times 4} = \frac{12}{36}$$

EXAMPLE 2: Add $^{1}/_{8}$ and $^{3}/_{4}$.

8 is the lowest number into which both 8 and 4 can be divided evenly.

$8 \div 8 = 1$

$8 \div 4 = 2$

$\frac{1}{8}$ remains as $^{1}/_{8}$ because 8 is the common denominator.

$$\frac{3}{4} = \frac{3 \times 2}{4 \times 2} = \frac{6}{8}$$

2. Add as like fractions and reduce or convert to mixed numbers as required

EXAMPLE 1: Add $^{11}/_{12}$ and $^{3}/_{9}$.

$$\frac{11}{12} = \frac{33}{36} \text{ and } \frac{3}{9} = \frac{12}{36}$$

$$\frac{33}{36} + \frac{12}{36} = \frac{33 + 12}{36} = \frac{45}{36} = \frac{5}{4} = 1\frac{1}{4}$$

EXAMPLE 2: Add $^{1}/_{8}$ and $^{3}/_{4}$.

$$\frac{1}{8} \text{ remains } \frac{1}{8} \text{ and } \frac{3}{4} = \frac{6}{8}$$

$$\frac{1}{8} + \frac{6}{8} = \frac{1 + 6}{8} = \frac{7}{8}$$

C. Mixed numbers

1. Add whole numbers

2. Add fractions, first finding common denominators if necessary, and reduce or convert to mixed numbers as necessary

3. Add the sums of steps 1 and 2

EXAMPLE 1: Add $3^{1}/_{8}$ and $7^{3}/_{8}$.

$3 + 7 = 10$ Add whole numbers.

$\frac{1}{8} + \frac{3}{8} = \frac{1 + 3}{8} = \frac{4}{8} = \frac{1}{2}$ Add fractions and reduce.

$10 + \frac{1}{2} = 10\frac{1}{2}$ Add the sums of steps 1 and 2.

EXAMPLE 2: Add $4^{2}/_{3}$ and $1^{5}/_{6}$.

$4 + 1 = 5$ Add whole numbers.

$\frac{2}{3} + \frac{5}{6} = \frac{4}{6} + \frac{5}{6}$ Find common denominator.

$\frac{4}{6} + \frac{5}{6} = \frac{9}{6} = 1\frac{3}{6} = 1\frac{1}{2}$ Add fractions, convert to mixed number, and reduce.

$5 + 1\frac{1}{2} = 6\frac{1}{2}$ Add sums of steps 1 and 2.

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XIII. Subtracting fractions

A. Like fractions

1. Subtract smaller numerator from larger numerator

   EXAMPLE: Subtract 1/16 from 7/16.

   $7 - 1 = 6$

2. Place subtraction answer over common denominator

   EXAMPLE: $\frac{6}{16}$

3. Reduce to lowest terms as required

   EXAMPLE: $\frac{6}{16} = \frac{3}{8}$

B. Unlike fractions

1. Change to like fractions

   EXAMPLE: Subtract 1/2 from 3/4.

   $\frac{3}{4}$ remains the same because 4 is the common denominator.

   $\frac{1}{2} = \frac{1 \times 2}{2 \times 2} = \frac{2}{4}$

2. Subtract as for like fractions

   EXAMPLE: $\frac{3}{4} - \frac{2}{4} = \frac{3 - 2}{4} = \frac{1}{4}$

3. Reduce to lowest terms as required

C. Mixed numbers

1. Convert mixed numbers to like fractions

   EXAMPLE: Subtract 3 1/2 from 5 1/8.

   $5\frac{1}{8} - 3\frac{1}{2} =$

   $5\frac{1}{8} - 3\frac{4}{8}$

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2. Borrow a one from the original whole number if needed, convert the one to a like fraction, and add it to the smaller fraction

   (NOTE: This step is needed only if the like fraction in the original number is smaller than the like fraction in the subtracted number.)

   EXAMPLE: $5\frac{1}{8} - 3\frac{4}{8} =$

   $(4\frac{8}{8} + \frac{1}{8}) - 3\frac{4}{8} =$

   $4\frac{9}{8} - 3\frac{4}{8}$

3. Subtract whole number from whole number and like fraction from like fraction

   EXAMPLE: $4\frac{9}{8} - 3\frac{4}{8} = 1\frac{5}{8}$

XIV. Multiplying fractions

A. Convert mixed numbers to improper fractions if necessary

B. Multiply numerators by numerators and denominators by denominators

C. Write the product of the numerators over the product of the denominators

D. Convert improper fractions to mixed numbers and reduce as required

EXAMPLE 1: Multiply $1/2$ by $3/4$.

$$\frac{1}{2} \times \frac{3}{4} = \frac{1 \times 3}{2 \times 4} = \frac{3}{8}$$

EXAMPLE 2: Multiply $1\,1/4$ by $1/2$.

$1\frac{1}{4} = \frac{5}{4}$ Convert to improper fraction.

$$\frac{5}{4} \times \frac{1}{2} = \frac{5 \times 1}{4 \times 2} = \frac{5}{8}$$

XV. Dividing fractions

(NOTE: Dividing fractions is just like multiplying fractions—except for the inversion step.)

A. Convert mixed numbers to improper fractions if necessary

B. Invert the second fraction—the divisor

C. Multiply numerators by numerators and denominators by denominators

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D. Write the product of the numerators over the product of the denominators

E. Convert improper fractions to mixed numbers and reduce as required

EXAMPLE 1: Divide $^7/_8$ by $^1/_4$.

$$\frac{7}{8} \div \frac{1}{4} = \frac{7}{8} \times \frac{4}{1} = \frac{7 \times 4}{8 \times 1} = \frac{28}{8} = 3\frac{4}{8} = 3\frac{1}{2}$$

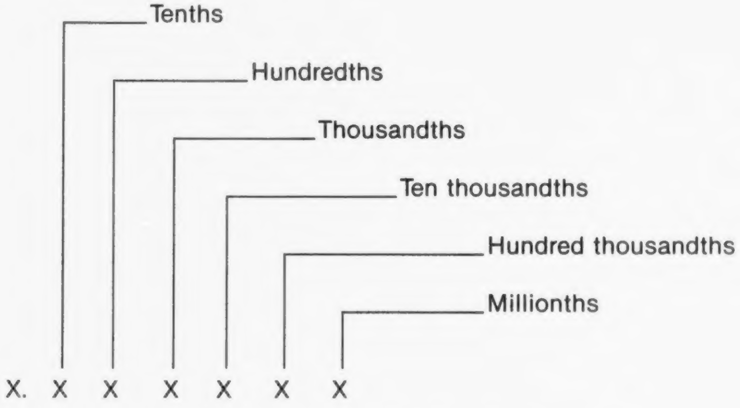
EXAMPLE 2: Divide 1 $^1/_4$ by $^1/_2$.

$$1\frac{1}{4} \div \frac{1}{2} = \frac{5}{4} \div \frac{1}{2} = \frac{5}{4} \times \frac{2}{1} = \frac{5 \times 2}{4 \times 1} = \frac{10}{4} = 2\frac{2}{4} = 2\frac{1}{2}$$

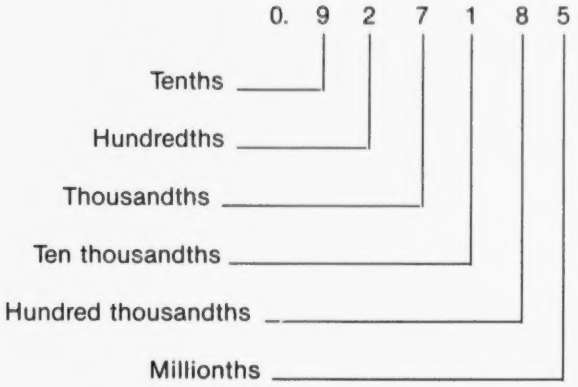
EXAMPLE 3: Divide 5 by $^3/_4$.

$$5 \div \frac{3}{4} = \frac{5}{1} \div \frac{3}{4} = \frac{5}{1} \times \frac{4}{3} = \frac{5 \times 4}{1 \times 3} = \frac{20}{3} = 6\frac{2}{3}$$

XVI. Place values of decimal numbers


Tenths
Hundredths
Thousandths
Ten thousandths
Hundred thousandths
Millionths
X. X X X X X X

EXAMPLE:


0. 9 2 7 1 8 5
Tenths
Hundredths
Thousandths
Ten thousandths
Hundred thousandths
Millionths

(NOTE: The number in the example is read as nine hundred twenty-seven thousand, one hundred eighty-five millionths.)

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XVII. Adding decimal numbers

A. Set up problem as for addition of whole numbers, aligning decimal points directly under each other

(NOTE: Zeros may be added to ensure that units line up under units, tens under tens, and so on. Whole numbers have an understood decimal point to the right of the units digit: 7 is 7., 75 is 75., and 754 is 754.)

EXAMPLE: Add 0.857, 2.1, 753, and 370.057.

$$\begin{array}{rcr} 0.857 & & 000.857 \\ 2.1 & & 002.100 \\ 753 & \text{or} & 753.000 \\ \underline{+\ 370.057} & & \underline{+\ 370.057} \end{array}$$

B. Add each column of numbers as for whole numbers

C. Locate the decimal point in the answer by placing it directly under the decimal points above

EXAMPLE:

$$\begin{array}{rl} 000.857 & \\ 002.100 & \\ 753.000 & \\ \underline{+\ 370.057} & \\ 1126.014 & \text{Answer} \end{array}$$

XVIII. Subtracting decimal numbers

A. Set up problem as for subtraction of whole numbers, aligning decimal points directly under each other

EXAMPLE: Subtract 1.397 from 8.120.

$$\begin{array}{rl} 8.120 & \text{Original Number} \\ \underline{-\ 1.397} & \text{Subtracted Number} \end{array}$$

B. Subtract each column of numbers as for whole numbers

C. Locate the decimal point in the answer by placing it directly under the decimal points above

D. Check your subtraction by adding your answer to the subtracted number

(NOTE: If you have solved the problem correctly, your check answer should be the same as the original number.)

EXAMPLE:

$$\begin{array}{rl} 8.120 & \text{Original Number} \\ \underline{-\ 1.397} & \text{Subtracted Number} \\ \underline{+\ 6.723} & \text{Answer (Difference)} \\ 8.120 & \text{Check Answer} \end{array}$$

INFORMATION SHEET

XIX. Multiplying decimal numbers

A. Set up problem and multiply as for multiplication of whole numbers

(NOTE: Do *not* align the decimal points in columns when setting up multiplication problems for decimal numbers.)

EXAMPLE: Multiply 27.935 by 7.07.

$$\begin{array}{rl} 27.935 & \text{Original Number} \\ \times\ \ 7.07 & \text{Multiplier} \\ \hline 195545 & \\ 1955450 & \\ \hline 19750045 & \end{array}$$

B. Add the number of decimal places to the right of the decimal points in the multiplier and original number

EXAMPLE:

$$\begin{array}{r} 27.935 \\ \times\ \ 7.07 \\ \hline \end{array} \qquad \begin{array}{rl} 3 & \text{Decimal Places} \\ +2 & \text{Decimal Places} \\ \hline 5 & \text{Total Decimal Places} \end{array}$$

C. Locate decimal point in answer by beginning at far right digit and counting off as many places to the left as the total decimal places found in Step B

EXAMPLE:

$$\begin{array}{rl} 27.935 & \\ \times\ \ 7.07 & \\ \hline 195545 & \\ 1955450 & \\ \hline 197.50045 & \text{5 Decimal Places} \end{array}$$

XX. Dividing decimal numbers

A. Set up problem as for division of whole numbers

EXAMPLE: Divide 0.25 by 0.005.

Divisor $0.005\overline{)0.25}$ Original Number

B. Move the decimal point in the divisor to the right of the far right digit in the divisor

EXAMPLE: $\underset{\curvearrowright}{0.005.}\overline{)0.25}$

C. Move the decimal point in the original number to the right by the same number of decimal places that you moved the decimal point in the divisor, adding zeros to the original number if necessary

EXAMPLE: $\underset{\curvearrowright}{0.005.}\overline{)\underset{\curvearrowright}{0.250.}}$

(NOTE: If you are dividing a decimal number into a whole number, remember that whole numbers have an understood decimal point to the right of the units digit.)

EXAMPLE: $0.03\overline{)9}$ becomes $\underset{\curvearrowright}{0.03.}\overline{)\underset{\curvearrowright}{9.00.}}$

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D. Place a decimal point in the answer space directly above the repositioned decimal point in the original number

EXAMPLE: $0.\underset{\curvearrowright}{005.}\overline{)0.\underset{\curvearrowright}{250.}}$

E. Divide as for whole numbers

EXAMPLE:
$$\begin{array}{r} 50.\\ 0005.\overline{)0250.}\\ \underline{025}\\ 00 \end{array}$$

F. Check your division by multiplying the original divisor (before decimal point was moved) by your answer and adding any remainder to this number

(NOTE: If you have solved the problem correctly, your check answer should be the same as the original number.)

EXAMPLE:
$$\begin{array}{rl} 0.005 & \text{Divisor}\\ \underline{\times\quad 50} & \text{Answer}\\ 0.250 & \text{Check Answer (Same as Original Number)} \end{array}$$

XXI. Converting fractions to decimals and percentages

A. Fractions to decimals — Divide the numerator by the denominator

EXAMPLE: Convert $^5/_8$ to a decimal.

$$\begin{array}{cl} \underline{5} & \text{Numerator}\\ 8 & \text{Denominator} \end{array} \qquad \begin{array}{r} 0.625\\ 8\overline{)5.000}\\ \underline{4\,8}\\ 20\\ \underline{16}\\ 40\\ \underline{40}\\ 0 \end{array}$$

B. Fractions to percentages

(NOTE: *Percent* means that a number is a fraction of 100.)

1. Convert the fractions to decimals by dividing numerator by denominator
2. Move the decimal point in the answer two places to the right
3. Place the percent symbol after the number

EXAMPLE: Convert $^7/_{33}$ to a percentage.

$$\begin{array}{cl} \underline{7} & \text{Numerator}\\ 33 & \text{Denominator} \end{array} \qquad \begin{array}{r} 0.2121\\ 33\overline{)7.0000}\\ \underline{6\,6}\\ 40\\ \underline{33}\\ 70\\ \underline{66}\\ 40\\ \underline{33}\\ 7 \end{array} = 21.21\%$$

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XXII. Decimal and fractional equivalents

$\frac{1}{64}$	.015625
$\frac{1}{32}$	.03125
$\frac{3}{64}$	.046875
$\frac{1}{16}$	.0625
$\frac{5}{64}$	.078125
$\frac{3}{32}$	.09375
$\frac{7}{64}$	.109375
$\frac{1}{8}$	**.125**
$\frac{9}{64}$	.140625
$\frac{5}{32}$	.15625
$\frac{11}{64}$	.171875
$\frac{3}{16}$	.1875
$\frac{13}{64}$	.203125
$\frac{7}{32}$	.21875
$\frac{15}{64}$	.234375
$\frac{1}{4}$	**.25**
$\frac{17}{64}$	.265625
$\frac{9}{32}$	.28125
$\frac{19}{64}$	.296875
$\frac{5}{16}$	.3125
$\frac{21}{64}$	.328125
$\frac{11}{32}$	.34375
$\frac{23}{64}$	.359375
$\frac{3}{8}$	**.375**
$\frac{25}{64}$	.390625
$\frac{13}{32}$	.40625
$\frac{27}{64}$	.421875
$\frac{7}{16}$	.4375
$\frac{29}{64}$	.453125
$\frac{15}{32}$	.46875
$\frac{31}{64}$	.484375
$\frac{1}{2}$	**.5**
$\frac{33}{64}$	.515625
$\frac{17}{32}$	.53125
$\frac{35}{64}$	.546875
$\frac{9}{16}$	.5625
$\frac{37}{64}$	.578125
$\frac{19}{32}$	.59375
$\frac{39}{64}$	.609375
$\frac{5}{8}$	**.625**
$\frac{41}{64}$	.640625
$\frac{21}{32}$	.65625
$\frac{43}{64}$	.671875
$\frac{11}{16}$	.6875
$\frac{45}{64}$	.703125
$\frac{23}{32}$	.71875
$\frac{47}{64}$	.734375
$\frac{3}{4}$	**.75**
$\frac{49}{64}$	.765625
$\frac{25}{32}$	.78125
$\frac{51}{64}$	.796875
$\frac{13}{16}$	.8125
$\frac{53}{64}$	.828125
$\frac{27}{32}$	.84375
$\frac{55}{64}$	.859375
$\frac{7}{8}$	**.875**
$\frac{57}{64}$	.890625
$\frac{29}{32}$	.90625
$\frac{59}{64}$	.921875
$\frac{15}{16}$	.9375
$\frac{61}{64}$	.953125
$\frac{31}{32}$	.96875
$\frac{63}{64}$	.984375
1	**.1**

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XXIII. Converting percentages to fractions and decimal numbers

A. Percentages to fractions

1. Drop the percent symbol
2. Place the number over 100
3. Reduce to lowest terms if necessary

EXAMPLE: Convert 38% to a fraction.

$$38\% = 38 = \frac{38}{100} = \frac{19}{50}$$

B. Percentages to decimals

1. Drop the percent symbol
2. Move decimal point two places to left

EXAMPLE: Convert 74% to a decimal.

$$74\% = 74 = 0.74$$

XXIV. Solving percentage problems

(NOTE: Percentage problems may involve solving for the percent ["16 is what percent of 80?"], the part ["What number is 20% of 80?"], or the whole ["16 is 20% of what number?"].)

A. Write the unknown as "X"

EXAMPLE: 16 is what percent of 80?

16 is X percent of 80.

(NOTE: The unknown may be the percent, the part, or the whole.)

B. Write the percent (known or unknown) as a fraction with a denominator of 100

EXAMPLE: 16 is $\frac{X}{100}$ percent of 80.

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C. Write the part and the whole as a fraction, writing the part as the numerator and the whole as the denominator

EXAMPLE: $\frac{16}{80} \quad \begin{matrix}\text{Part}\\ \text{Whole}\end{matrix}$

D. Set up the equation by writing the two fractions with an equal sign between them

EXAMPLE: $\frac{X}{100} = \frac{16}{80}$

E. Solve the equation by multiplying the numerator of each fraction by the denominator of the other

(NOTE: This process is known as *cross multiplying*.)

EXAMPLE: $\frac{X}{100} = \frac{16}{80}$

$80X = 1600$

F. Divide each side of the equation by the multiplier of X

EXAMPLE: $80X = 1600$

$X = 20\%$

16 is 20% of 80.

XXV. Terms used in geometry

A. Geometric figure — Shape formed by straight or curved lines

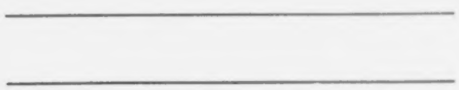
B. Perimeter — Outer limits or boundary

C. Lineal — Relating to, consisting of, or resembling a straight line

D. Parallel — Extending in the same direction; equal distance apart and never meeting (Figure 2)

EXAMPLE:

FIGURE 2



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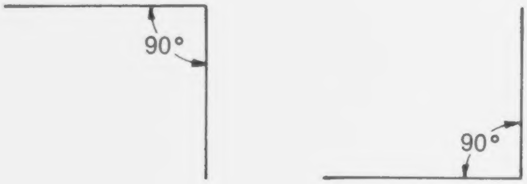
E. Right angle — Angle formed by two lines perpendicular to each other; 90-degree angle (Figure 3)

EXAMPLE:

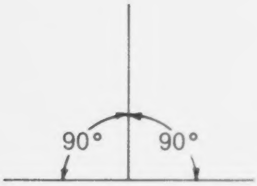
FIGURE 3



F. Perpendicular — Line or surface at a right angle to another line or surface (Figure 4)

EXAMPLE:

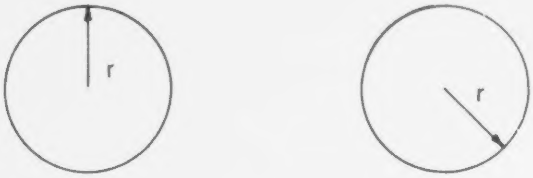
FIGURE 4



G. Radius — Line from center of a circle to any point on edge of circle (Figure 5)

EXAMPLE:

FIGURE 5



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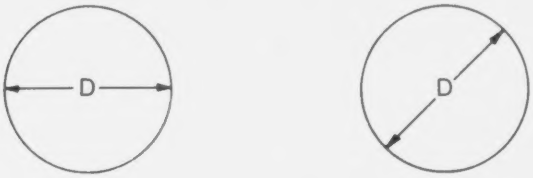
H. Diameter — Distance between outer edges of a circle through center point (Figure 6)

EXAMPLE:

FIGURE 6



I. Circumference — Distance around outer edge of a circle

J. Pi — Greek letter (π) representing the ratio of a circle's circumference to its diameter; ratio approximately 3.1416

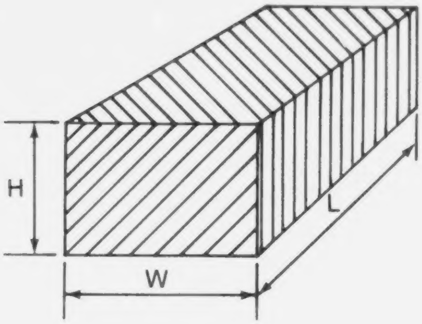
K. Area — Measure of a flat surface; expressed in square units

EXAMPLE: W × L = Area

L. Volume — Space occupied by a body; expressed in cubic units (Figure 7)

EXAMPLE:

FIGURE 7



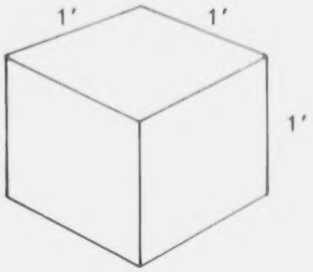
M. Cubic unit — Unit with three equal dimensions including length, width, and height

INFORMATION SHEET

N. Cubic foot — Volume of an object that is 1 foot long, 1 foot wide, and 1 foot high (Figure 8)

EXAMPLE:

FIGURE 8



XXVI. Types of geometric figures (Figures 9-15)

A. Square — Figure having four sides of equal length and four right angles

EXAMPLE:

FIGURE 9

B. Rectangle — Figure with two parallel ends of equal length, two parallel sides of equal length, and four right angles

EXAMPLE:

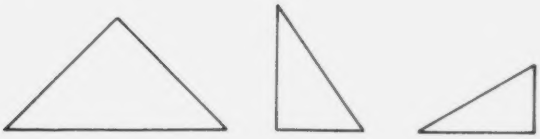
FIGURE 10

INFORMATION SHEET

C. Triangle — Figure having three sides and three angles

EXAMPLES:

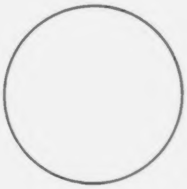
FIGURE 11



D. Circle — Flat, round figure formed by one curved line; all points of curved line are equidistant from center point

EXAMPLE:

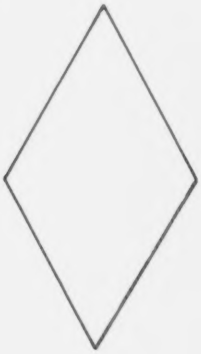
FIGURE 12



E. Rhombus — Figure having no right angles and four sides of equal length

EXAMPLE:

FIGURE 13



INFORMATION SHEET

F. Parallelogram — Figure such as a square, rectangle, or rhombus with two parallel ends of equal length and two parallel sides of equal length

EXAMPLE:

FIGURE 14

G. Trapezoid — Figure with only one pair of parallel opposite sides

EXAMPLE:

FIGURE 15

XXVII. Units of measure and their equivalents

A. Inch (″) — Equal to one-twelfth of a foot (1/12′) or one thirty-sixth of a yard (1/36 yard)

B. Foot (′) — Equal to twelve inches (12″) or one-third of a yard (1/3 yard)

C. Yard — Equal to three feet (3′) or thirty-six inches (36″)

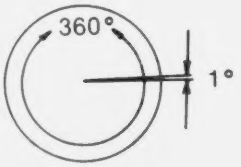
D. Rod — Equal to sixteen and one-half feet (16 1/2′)

E. Mile — Equal to five thousand, two hundred and eighty feet (5280′)

F. Degree (°) — Equal to 1/360 of a circle (Figure 16)

EXAMPLE:

FIGURE 16



INFORMATION SHEET

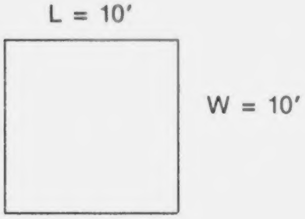
XXVIII. Calculating area of geometric figures (Figures 17-22)

(NOTE: Area is always labeled in square units of measure.)

A. Square — Use the formula Area = Length × Width or A = LW

EXAMPLE:

FIGURE 17



$A = LW$

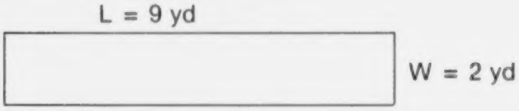
$= 10 \times 10$

$= 100$ square feet

B. Rectangle — Use the formula Area = Length × Width or A = LW

EXAMPLE:

FIGURE 18



$A = LW$

$= 9 \times 2$

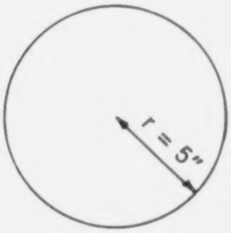
$= 18$ square yards

C. Circle — Use the formula Area $= \pi r^2$ (radius × radius)

(NOTE: Pi [π] is 3.14, which is the circumference of a circle divided by the diameter of the circle.)

EXAMPLE:

FIGURE 19



$A = \pi r^2$

$= 3.14 \times (5 \times 5)$

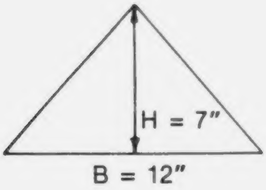
$= 78.50$ square inches

INFORMATION SHEET

D. Triangle — Use the formula Area = $\frac{1}{2}$ Base × Height, or A = $\frac{1}{2}$ BH

EXAMPLE:

FIGURE 20



$$A = \frac{1}{2}BH$$

$$= (\frac{1}{2} \times 12) \times 7$$

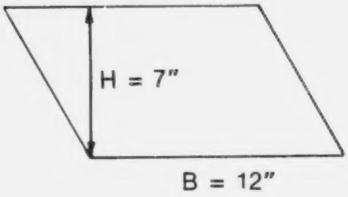
$$= 6 \times 7$$

$$= 42 \text{ square inches}$$

E. Parallelogram — Use the formula Area = Base × Height, or A = BH

EXAMPLE:

FIGURE 21



$$A = BH$$

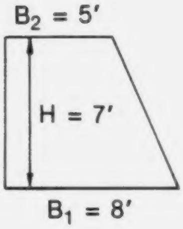
$$= 12 \times 7$$

$$= 84 \text{ square inches}$$

F. Trapezoid — Use the formula Area = $\frac{1}{2}H(B_1 + B_2)$

EXAMPLE:

FIGURE 22



$$A = \frac{1}{2}H(B_1 + B_2)$$

$$= (\frac{1}{2} \times 7) \times (8 + 5)$$

$$= \frac{7}{2} \times 13$$

$$= \frac{7}{2} \times \frac{13}{1}$$

$$= \frac{91}{2}$$

$$= 45\frac{1}{2} \text{ square feet}$$

INFORMATION SHEET

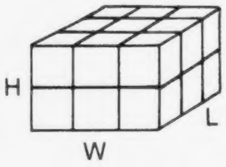
XXIX. Calculating volume of solid figures

(NOTE: Volume is always measured in cubic units.)

A. Using counting method — Use formula Cubic Units = Number of Cubes in Layer × Number of Layers (Figure 23)

EXAMPLE:

FIGURE 23



Cubic Units = Number of Cubes in Layer × Number of Layers

= 9 × 2

= 18 cubes

B. Using formula and converting as necessary

1. Using formula Volume = Length × Width × Height or $V = LWH$

EXAMPLE 1: Where $L = 3$ feet, $W = \frac{1}{2}$ foot, and $H = 1\frac{1}{2}$ feet

$$V = LWH$$

$$= 3 \times \frac{1}{2} \times 1\frac{1}{2}$$

$$= \frac{9}{4} \text{ or } 2\frac{1}{4} \text{ cubic feet}$$

EXAMPLE 2: Where $L = 10$ feet, $W = 8$ feet, and $H = 3$ feet

$$V = LWH$$

$$= 10 \times 8 \times 3$$

$$= 240 \text{ cubic feet}$$

2. Converting using formula

$$\text{Cubic Yards} = \frac{\text{Width in Feet} \times \text{Length in Feet} \times \text{Thickness in Feet}}{27}$$

INFORMATION SHEET

(NOTE: The formula for converting will differ, depending on the units being converted. The formula for cubic yards is given in the example because it is the conversion most often used by concrete masons. Because given measurements are usually in feet and inches, thickness in inches must be broken down by using fractions or decimals.)

EXAMPLE 1: Converting to yards, using fractions where width = 30′, length = 60′, and thickness = 4″

$$\text{Cubic Yards} = \frac{\text{Width in Feet} \times \text{Length in Feet} \times \text{Thickness in Feet}}{27}$$

$$= \frac{30' \times 60' \times 4''}{27}$$

$$= \frac{30' \times 60' \times \frac{1}{3}'}{27}$$

$$= 22.22 \text{ cubic yards}$$

EXAMPLE 2: Converting to yards, using decimals where width = 30′, length = 60′, and thickness = 4″

$$\text{Cubic Yards} = \frac{\text{Width in Feet} \times \text{Length in Feet} \times \text{Thickness in Feet}}{27}$$

$$= \frac{30' \times 60' \times .33'}{27}$$

$$= \frac{594}{27}$$

$$= 22 \text{ cubic yards}$$

XXX. Solving ratio and proportion problems — To increase or decrease proportionally, multiply or divide each number in the ratio by the same number

(NOTE: Ratio indicates parts of material per mix; proportion indicates that the ratio is the same but the quantity may differ.)

EXAMPLE 1: You want to find half of the ratio 1:1:3.

Divide each number in the ratio by 2 to get 0.5:0.5:1.5.

EXAMPLE 2: You need three times the ratio 1:1:3.

Multiply each number in the ratio by 3 to get 3:3:9.

BASIC MATH
UNIT I

ASSIGNMENT SHEET #1 — ADD WHOLE NUMBERS

NAME ______________________________ SCORE ______________

Like most people, you probably use addition every day. For example, today you probably added coins together to pay for sodas and snacks. Every time you add, you use basic addition facts. The following exercises will form part of your concrete masonry math background and serve as a basis for completing other exercises and problems.

EXAMPLES:		1 ←Carried Digit	11 ←Carried Digits
	5	67	539
	+ 10	+ 25	333
	15	92	+ 432
			1304

PART I

Solve each of the following addition problems. Refer to Information Sheet, Section IV, if necessary, and show your work.

A. 2	B. 8	C. 7	D. 15	E. 81
+ 9	+ 8	+ 6	+ 8	+ 27

F. 7	G. 55	H. 341	I. 472	J. 9876
38	88	428	564	5432
+ 43	+ 99	+ 769	+ 881	+ 1122

PART II

A. If a concrete mason used 330 lineal feet of two-by-four on one form, 570 lineal feet on another, and 275 on another, how many lineal feet were used?

Total lineal feet = ____________

B. A contractor ordered the following number of doors at different dates: 256, 62, 575, and 242. How many doors should he be billed for?

Total doors = ____________

ASSIGNMENT SHEET #1

C. If a contractor paid $480 for doors, $13 for trim, $81 for hardware, and $35 for shelving, what was the total cost of the materials?

Total cost of materials = $____________

D. If it takes 1135 square feet of concrete for the first slab, 1225 square feet for the second, 1220 square feet for the third, 1125 square feet for the fourth, and 7425 square feet for the last slab, what would be the total square feet of concrete needed?

Total square feet = ____________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #2 — SUBTRACT WHOLE NUMBERS

NAME ______________________________ SCORE ______________

Addition is the first fundamental operation in mathematics. Subtraction, the opposite of addition, is the process of finding the difference between two numbers. It is the second fundamental operation. You can check the accuracy of the answer obtained in a subtraction problem by simply adding the difference to the subtracted number. The sum of these two numbers will equal the original number if the answer is correct.

EXAMPLES:

12	Original Number	57	Original Number
− 7	Subtracted Number	− 35	Subtracted Number
+ 5	Answer (Difference)	+ 22	Answer (Difference)
12	Check Answer (Same as original number)	57	Check Answer

PART I

Solve each of the following subtraction problems. Check your answers by adding the difference to the subtracted number. Refer to Information Sheet, Section V, if necessary, and show your work.

A. $\begin{array}{r} 9 \\ -5 \\ \hline \end{array}$ B. $\begin{array}{r} 15 \\ -\ 8 \\ \hline \end{array}$ C. $\begin{array}{r} 75 \\ -22 \\ \hline \end{array}$ D. $\begin{array}{r} 453 \\ -\ 47 \\ \hline \end{array}$ E. $\begin{array}{r} 742 \\ -318 \\ \hline \end{array}$

F. $\begin{array}{r} 981 \\ -698 \\ \hline \end{array}$ G. $\begin{array}{r} 1420 \\ -\ 245 \\ \hline \end{array}$ H. $\begin{array}{r} 3459 \\ -1649 \\ \hline \end{array}$ I. $\begin{array}{r} 55722 \\ -\ 4272 \\ \hline \end{array}$ J. $\begin{array}{r} 98679 \\ -\ 8957 \\ \hline \end{array}$

PART II

A. If a sidewalk form takes 172 two-by-fours and you have 46, how many more two-by-fours would you need for the form job?

Number of two-by-fours = ____________

ASSIGNMENT SHEET #2

B. If you have 542 square feet of plastic and it takes 1702 square feet of plastic to complete the job, how many more square feet will you need?

Number of square feet needed = ____________

C. You have 6520 square feet of concrete to replace on a remodeling job. You have 470 square feet credited to your account from another job and 1640 square feet credited to your account from another job. How many more square feet will you need to pay for to complete the job?

Number of square feet needed = ____________

D. A concrete mason ordered 48,000 curb clamps. Of these, she used 4,850 on one job, 12,720 on another job, and 16,285 on another job. How many curb clamps did she have left?

Number of curb clamps left = ____________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #3 — MULTIPLY WHOLE NUMBERS

NAME ______________________________ SCORE ______________

Multiplication is the third basic operation in mathematics. It is a shortcut method of adding. For example, if you correctly add twelve 12s, the result will be 144, the same as 12 multiplied by 12. Some multiplication problems involve carrying. You may write down the carried digits, or simply remember them. Use the method that works best for you.

When multiplying by numbers that contain two or more digits, you must be careful to align the partial products properly. Write the right-hand digit of each partial product directly below the multiplying digit. This causes the partial products to be properly aligned so that tens will be added to tens, hundreds to hundreds, and so on.

EXAMPLES:

$$\begin{array}{r} 8 \\ \times\ 7 \\ \hline 56 \end{array} \qquad \begin{array}{rl} 1 & \leftarrow \text{Carried Digit} \\ 53 & \\ \times\ \ 4 & \\ \hline 212 & \end{array} \qquad \begin{array}{rl} 11\ \ & \leftarrow \text{Carried Digits} \\ 756 & \\ \times\ 312 & \\ \hline 1512 & \leftarrow \text{First Partial Product} \\ 756\ \ & \leftarrow \text{Second Partial Product} \\ 2268\ \ \ \ & \leftarrow \text{Third Partial Product} \\ \hline 235872 & \leftarrow \text{Product} \end{array}$$

PART I

Solve each of the following multiplication problems. Refer to Information Sheet, Section VI, if necessary, and show your work.

A. $\begin{array}{r} 6 \\ \times\ 7 \\ \hline \end{array}$ B. $\begin{array}{r} 9 \\ \times\ 8 \\ \hline \end{array}$ C. $\begin{array}{r} 54 \\ \times\ \ 6 \\ \hline \end{array}$ D. $\begin{array}{r} 721 \\ \times\ \ \ 4 \\ \hline \end{array}$ E. $\begin{array}{r} 1682 \\ \times\ \ \ \ 5 \\ \hline \end{array}$

F. $\begin{array}{r} 78 \\ \times\ 26 \\ \hline \end{array}$ G. $\begin{array}{r} 453 \\ \times\ \ 47 \\ \hline \end{array}$ H. $\begin{array}{r} 314 \\ \times\ 527 \\ \hline \end{array}$ I. $\begin{array}{r} 2143 \\ \times\ \ 235 \\ \hline \end{array}$ J. $\begin{array}{r} 4123 \\ \times\ 1324 \\ \hline \end{array}$

ASSIGNMENT SHEET #3

PART II

A. If one load of concrete weighs 9769 pounds, how much would 7 loads weigh?

Weight = ____________

B. If a concrete mason can install an average of 170 square feet of topping per hour, how many square feet can she install in 48 hours?

Number of square feet = ____________

C. Six concrete masons lay an average of 950 square feet of sidewalk per person per day. What will be each mason's average for 3 days' work?

Average = ____________

D. Figure the amount of time worked in 4 weeks by 12 concrete masons who work 30 hours each week.

Hours worked = ____________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #4 — DIVIDE WHOLE NUMBERS

NAME ____________________ SCORE ____________

Concrete masons use division in many aspects of their work. Tilt-up slabs, precast slabs, and other construction features are often installed in sets of the same size units. By dividing the space allowed for such structures by the size of the individual units, the concrete mason can determine the number of units required. Division is also used to compute costs and expenses and in making estimates.

Division is the fourth and last basic operation in mathematics. Multiplication puts together—division takes apart. Division is the reverse of multiplication. *Long division* is the name used for division by numbers that cannot readily be used as simple dividers. Division answers are checked by multiplying the divisor by the answer and adding the remainder.

EXAMPLES:

$$\begin{array}{r} \text{Answer} \\ \text{Divisor}\,\overline{)\text{Original Number}} \end{array} \qquad \begin{array}{r} 324 \\ 3\,\overline{)972} \\ \underline{9} \\ 7 \\ \underline{6} \\ 12 \\ \underline{12} \end{array}$$

$$\begin{array}{rl} 0111 & \text{Answer} \\ 51\,\overline{)5678} & \\ \underline{51} & \\ 57 & \\ \underline{51} & \\ 68 & \\ \underline{51} & \\ 17 & \text{Remainder} \end{array} \qquad \text{Check:} \quad \begin{array}{rl} 111 & \text{Answer} \\ \underline{\times\ 51} & \text{Divisor} \\ 111 & \\ \underline{555} & \\ 5661 & \\ \underline{+\ 17} & \text{Remainder} \\ 5678 & \text{Original Number} \end{array}$$

PART I

Solve each of the following division problems. Check your answers by multiplying the divisor by the original number. Refer to Information Sheet, Section VII, if necessary, and show your work.

A. $2\,\overline{)8}$ B. $6\,\overline{)48}$ C. $9\,\overline{)819}$ D. $4\,\overline{)1248}$ E. $13\,\overline{)39}$

ASSIGNMENT SHEET #4

F. $66\overline{)198}$ G. $84\overline{)5212}$ H. $124\overline{)345}$ I. $464\overline{)829}$ J. $746\overline{)2872}$

PART II

A. Four concrete masons working together laid 8280 square feet of concrete in one day. What was the average number of square feet laid by each concrete mason that day?

Average square feet = ________________________

B. A home buyer has requested that one wall of a dining room be done in 1-foot-by-4-foot windows. How many windows can be installed if the wall is 108 inches long and the windows, with connecting mulls, are 13 inches wide? How much space will be left?

Number of windows installed = ________________________

Amount of space left = ________________________

C. A contractor built 26 houses. The project required 25,350 square feet of colored concrete. How much colored concrete was required on the average per house?

Square feet of colored concrete = ________________________

D. A sheet of 4-foot-by-8-foot plywood is 32 square feet. How many sheets of plywood would be required to deck a roof area of 2176 square feet if no allowance is made for waste?

Number of sheets of plywood = ________________________

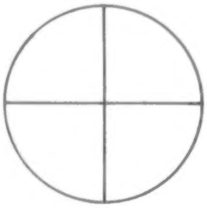
BASIC MATH
UNIT I

ASSIGNMENT SHEET #5 — WORK WITH FRACTIONS

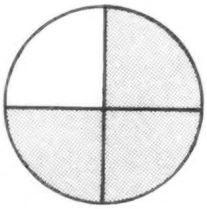
NAME ______________________________ SCORE ____________

Fractions are essential to the concrete masonry trade. Not only does the concrete mason frequently use fractions for measurements, but much of the material used in the trade is sized by fractional units. Expansion-joint material comes in sizes $\frac{1}{2}$- and $\frac{5}{8}$-inch thick. Even lumber that is referred to in even numbers is actually measured in fractional inches. For example, a two-by-four board is actually $1\frac{1}{2}$ inches × $3\frac{1}{2}$ inches. This frequent use of fractions in the trade makes it necessary for the good concrete mason to understand thoroughly how to work with fractions.

When something is divided into parts that are all the same size, or of equal size, it is divided into fractional parts. For example, the circle below is divided into four fractional parts.



To talk about fractional parts, you use fractions. For example, one of the four parts of the circle below is unshaded, or $\frac{1}{4}$ of the circle is unshaded; three of the four parts of the circle are shaded, or $\frac{3}{4}$ of the circle is shaded.



In the fraction $\frac{3}{4}$, the 4 is called the *denominator*. It shows the number of equal parts into which the circle is divided. The 3 is called the *numerator*. It shows the number of parts that are used.

PART I

A. Identify the numerator and denominator of each of the following fractions by filling in the blanks. Refer to Information Sheet, Section VIII, if necessary.

1. In the fraction $\frac{5}{8}$, the numerator is ______ and the denominator is ______.

ASSIGNMENT SHEET #5

2. In the fraction 7/16, 7 is the ______________________________ and 16 is the ______________________________.

3. In the fraction 1/4, what is the numerator? ______ denominator? ______

B. Write the fractions that fit the following statements.

_____________________1. A fraction with a denominator of 16 and a numerator of 10.

_____________________2. A fraction with a numerator of 16 and a denominator of 32.

C. A concrete mason divides a sidewalk into 8 equal sections and then takes out 1 of the 8 sections.

_____________________1. Which number represents the numerator?

_____________________2. Which number represents the denominator?

_____________________3. What fractional part of the sidewalk did the concrete mason take out?

PART II

A. Match the shaded portions of the following figures to the fractions they represent. Write the correct letters in the blanks.

_____ 1. 4/8

_____ 2. 2/2

_____ 3. 6/16

_____ 4. 3/8

_____ 5. 5/8

_____ 6. 1/2

_____ 7. 7/16

_____ 8. 3/4

_____ 9. 1/4

_____10. 1/8

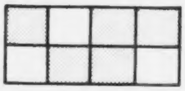
_____11. 7/8

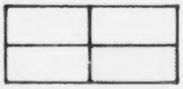
_____12. 2/4

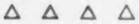
_____13. 2/8

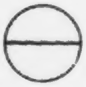
_____14. 13/16

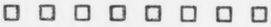
_____15. 6/8

a.


b.


c.


d.


e.


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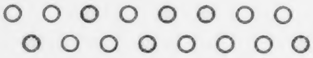
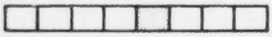
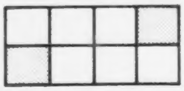
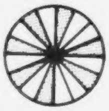
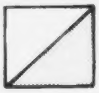
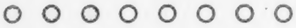


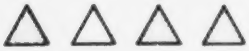
g.


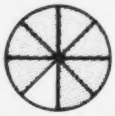
h.


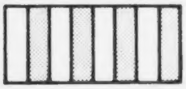
i.


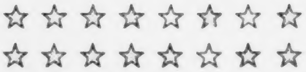
j.


k.


l.


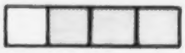
m.


n.


o.


ASSIGNMENT SHEET #5

B. Draw a figure shaded to represent each of the following fractions.

EXAMPLE: 3/4


1. 1/2

2. 3/4

3. 5/8

4. 1/4

5. 7/8

6. 5/16

7. 2/8

8. 3/16

9. 3/8

10. 13/16

BASIC MATH
UNIT I

ASSIGNMENT SHEET #6 — REDUCE FRACTIONS TO LOWEST TERMS

NAME ______________________________ SCORE ______________

Fractions are "reduced" to their lowest terms so that they are more readily understood or recognized. For example, $^{1}/_{2}$ is more easily recognized than $^{16}/_{32}$.

To reduce a fraction to its lowest terms, divide the numerator and the denominator by the largest whole number that will go into both evenly.

EXAMPLES: $\frac{9}{12} = \frac{9 \div 3}{12 \div 3} = \frac{3}{4}$ $\frac{12}{32} = \frac{12 \div 4}{32 \div 4} = \frac{3}{8}$

Reduce the following fractions to their lowest terms. Refer to Information Sheet, Section IX, if necessary.

A. $^{4}/_{8}$ = ______

B. $^{8}/_{16}$ = ______

C. $^{2}/_{2}$ = ______

D. $^{4}/_{16}$ = ______

E. $^{12}/_{48}$ = ______

F. $^{9}/_{24}$ = ______

G. $^{16}/_{32}$ = ______

H. $^{2}/_{4}$ = ______

I. $^{9}/_{12}$ = ______

J. $^{50}/_{100}$ = ______

BASIC MATH
UNIT I

ASSIGNMENT SHEET #7 — CONVERT UNLIKE FRACTIONS TO LIKE FRACTIONS

NAME ______________________________ SCORE ______________

Fractions must have common denominators if they are to be added or subtracted. Fractions that have the same denominator are said to have a *common* denominator and to be *like fractions.* The easiest way to find a common denominator for two fractions is to multiply the numerator and the denominator of each fraction by the denominator of the other fraction.

EXAMPLE: Find a common denominator for the fractions $^1/_4$ and $^3/_{16}$ and convert to like fractions.

$$\frac{1}{4} = \frac{1 \times 16}{4 \times 16} = \frac{16}{64} \quad \text{and} \quad \frac{3}{16} = \frac{3 \times 4}{16 \times 4} = \frac{12}{64}$$

Because a common denominator is any denominator into which the denominators of both fractions will divide evenly, two fractions can have a number of common denominators. Although it is easy to find common denominators by multiplying the denominators by one another, this often leads to numbers that are awkward to work with. For that reason, fractions are usually added after the *lowest* common denominator has been found.

EXAMPLE: Common denominators for the fractions $^1/_4$ and $^3/_{16}$ include 16, 32, 48, 64, 80, and many more.

$^4/_{16}$ and $^3/_{16}$
$^8/_{32}$ and $^6/_{32}$
$^{12}/_{48}$ and $^9/_{48}$
$^{16}/_{64}$ and $^{12}/_{64}$
$^{20}/_{80}$ and $^{15}/_{80}$

The lowest common denominator is the lowest one into which the others can be divided evenly. To find the lowest common denominator, find any common denominator by the method shown above, and reduce it.

EXAMPLE: Convert the fractions $^6/_{15}$ and $^3/_{10}$ to like fractions with the lowest common denominator.

$$\frac{6}{15} = \frac{6 \times 10}{15 \times 10} = \frac{60}{150} = \frac{12}{30} \quad \text{and} \quad \frac{3}{10} = \frac{3 \times 15}{10 \times 15} = \frac{45}{150} = \frac{9}{30}$$

ASSIGNMENT SHEET #7

To change a fraction to its equivalent with a higher denominator, multiply the denominator of the given fraction by a number that will give the desired denominator; then multiply the numerator of the fraction by the same multiplier.

EXAMPLE: You want to find out how many eighths there are in $^1/_2$.

$\frac{1}{2 \times 4} = \frac{?}{8}$ Multiply the denominator by 4 to give you the eighths denominator.

$\frac{1}{2} = \frac{?}{8}$ $\frac{1 \times 4}{2 \times 4} = \frac{4}{8}$ $\frac{1}{2} = \frac{4}{8}$

To change a fraction to its equivalent with a lower denominator, divide both the denominator and the numerator by the same number.

EXAMPLE: You want to find out how many fourths there are in $^{12}/_{16}$.

$\frac{12}{16} = \frac{?}{4}$ $\frac{12 \div 4}{16 \div 4} = \frac{3}{4}$ $\frac{12}{16} = \frac{3}{4}$

PART I

Convert each of the fractions below to equivalent fractions for the denominator given.

A. $\frac{1}{2} = \frac{}{8}$

B. $\frac{1}{4} = \frac{}{32}$

C. $\frac{12}{16} = \frac{}{4}$

D. $\frac{10}{32} = \frac{}{16}$

E. $\frac{6}{8} = \frac{}{4}$

F. $\frac{5}{8} = \frac{}{32}$

G. $\frac{9}{16} = \frac{}{32}$

H. $\frac{18}{32} = \frac{}{16}$

I. $\frac{3}{4} = \frac{}{8}$

J. $\frac{7}{8} = \frac{}{32}$

K. $\frac{24}{32} = \frac{}{4}$

L. $\frac{28}{64} = \frac{}{16}$

PART II

Multiply the denominators in the following sets of fractions to convert them to like fractions.

A. $\frac{3}{8}$ and $\frac{1}{2}$ = __________ and __________

B. $\frac{3}{4}$ and $\frac{9}{32}$ = __________ and __________

ASSIGNMENT SHEET #7

C. $\frac{1}{16}$ and $\frac{5}{8}$ = __________ and __________

D. $\frac{1}{2}$ and $\frac{7}{16}$ = __________ and __________

E. $\frac{3}{4}$ and $\frac{9}{16}$ and $\frac{7}{32}$ = __________ and __________ and __________

PART III

Change the following sets of fractions to like fractions with the *lowest* common denominators.

A. $\frac{3}{10}$ and $\frac{1}{4}$ = __________ and __________

B. $\frac{2}{3}$ and $\frac{3}{16}$ = __________ and __________

C. $\frac{3}{4}$ and $\frac{9}{32}$ = __________ and __________

D. $\frac{1}{2}$ and $\frac{7}{16}$ = __________ and __________

E. $\frac{3}{4}$ and $\frac{5}{8}$ and $\frac{7}{10}$ = __________ and __________ and __________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #8 — CONVERT FRACTIONS AND MIXED NUMBERS

NAME ________________________________ SCORE ______________

A fraction such as $^{3}/_{4}$ is called a *proper fraction* because its numerator (top number) is smaller than its denominator (bottom number). Some examples of proper fractions are $^{2}/_{3}$, $^{1}/_{5}$, and $^{7}/_{8}$.

When the numerator of a fraction is the same, or larger, than the denominator, the fraction is called an *improper fraction.* Some examples of improper fractions are $^{4}/_{4}$, $^{5}/_{3}$, $^{9}/_{4}$, and $^{10}/_{8}$.

Numbers such as $2^{1}/_{2}$, $5^{3}/_{4}$, and $6^{2}/_{5}$ are called *mixed numbers.* They are made up of a whole number and a proper fraction.

Complete the following exercises. Refer to Information Sheet, Sections VIII, X, and XI, if necessary.

PART I

A. Distinguish among the following fractions by writing a "P" in the blanks before a proper fraction, an "I" before an improper fraction, and an "M" in the blanks before a mixed number.

_____ 1. $^{1}/_{2}$

_____ 2. $3^{7}/_{8}$

_____ 3. $^{16}/_{2}$

_____ 4. $3^{1}/_{8}$

_____ 5. $^{1}/_{4}$

_____ 6. $^{1}/_{1}$

_____ 7. $^{7}/_{2}$

_____ 8. $8^{1}/_{2}$

_____ 9. $^{4}/_{4}$

_____10. $9\,^{3}/_{16}$

_____11. $5^{1}/_{2}$

_____12. $^{9}/_{8}$

_____13. $^{9}/_{4}$

_____14. $^{1}/_{8}$

_____15. $16\,^{3}/_{4}$

B. Write a numerator over each of the following denominators to make proper fractions.

1. $\frac{\quad}{8}$

2. $\frac{\quad}{4}$

3. $\frac{\quad}{32}$

4. $\frac{\quad}{2}$

5. $\frac{\quad}{16}$

ASSIGNMENT SHEET #8

C. Write a numerator over each of the following denominators to make improper fractions.

1. $\frac{\quad}{2}$

2. $\frac{\quad}{4}$

3. $\frac{\quad}{16}$

4. $\frac{\quad}{8}$

5. $\frac{\quad}{4}$

PART II

A. Convert each of the following mixed numbers to improper fractions. Reduce to lowest terms when possible.

1. $3^{1}/_{4}$ = ______
2. $4^{1}/_{2}$ = ______
3. $7^{3}/_{4}$ = ______
4. $8^{1}/_{2}$ = ______
5. $6^{1}/_{8}$ = ______
6. $5^{2}/_{4}$ = ______
7. $4^{1}/_{4}$ = ______
8. $9^{1}/_{2}$ = ______
9. $9^{1}/_{4}$ = ______
10. $16^{1}/_{2}$ = ______

B. Convert each of the following improper fractions to mixed numbers. Reduce to lowest terms when possible.

1. ${}^{7}/_{4}$ = ______
2. ${}^{9}/_{2}$ = ______
3. ${}^{6}/_{4}$ = ______
4. ${}^{15}/_{8}$ = ______
5. ${}^{19}/_{16}$ = ______
6. ${}^{11}/_{8}$ = ______
7. ${}^{75}/_{32}$ = ______
8. ${}^{5}/_{2}$ = ______
9. ${}^{15}/_{4}$ = ______
10. ${}^{33}/_{16}$ = ______

BASIC MATH
UNIT I

ASSIGNMENT SHEET #9 — ADD FRACTIONS

NAME ______________________________ SCORE ______________

One of the most common calculations done by a concrete mason is the addition of fractions. For example, boards are seldom cut to lengths of even feet or inches. Often the length of a cut can only be determined by adding several dimensions, any of which may include a fraction. For accurate construction, the lengths must be figured correctly.

To add common fractions, change to equivalent fractions with lowest common denominators. Add the new numerators and place this sum over the lowest common denominator. If the result is an improper fraction, change it to a mixed number and reduce to lowest terms.

EXAMPLE: $\frac{2}{3} + \frac{3}{4} = \frac{8}{12} + \frac{9}{12} = \frac{17}{12} = 1\frac{5}{12}$

Find common denominators and add the following fractions. Reduce to lowest terms. Refer to Information Sheet, Section XII, if necessary.

A. $\frac{1}{4} + \frac{2}{8} =$ __________

B. $\frac{4}{16} + \frac{3}{4} =$ __________

C. $\frac{5}{8} + \frac{3}{32} =$ __________

D. $\frac{9}{16} + \frac{5}{8} =$ __________

E. $\frac{3}{4} + \frac{5}{32} =$ __________

F. $\frac{7}{8} + \frac{5}{16} =$ __________

G. $\frac{9}{16} + \frac{3}{4} =$ __________

H. $\frac{4}{4} + \frac{25}{32} =$ __________

ASSIGNMENT SHEET #9

I. An epoxy resin for a special floor slab requires mixing a base liquid and a hardener. How many gallons of epoxy will be produced if you must mix 1 pint of hardener with 2 quarts of base?

(NOTE: There are 8 pints in a gallon. There are 4 quarts in a gallon.)

Gallons of epoxy = ____________________

J. A contractor puts both fiberboard and foil-backed styrofoam insulation on the exterior walls of houses. How much does this increase the thickness of a wall if the actual thickness of the fiberboard is $7/16$ inch and the actual thickness of the insulation is $21/32$ inch?

Increase in thickness = ____________________

K. Composition shingles are sold by the "square" — that is, the shingles required to cover 100 square feet of roof. There are three bundles of shingles per square. How many squares of shingles are left if a contractor has five bundles of shingles left from one job and two bundles left from another?

Number of squares = ____________________

L. How high above the subflooring must a carpenter hang a door if the door must clear the carpeting by $1/8$ inch, the carpet pad is $1/2$ inch thick, and the carpet is $9/16$ inch thick?

Height above subflooring = ____________________

M. A carpenter needs a door jamb that will cover the end of a wall that has $3/8$ inch of paneling and $1/2$ inch of plasterboard on each side of a $3\,1/2$-inch wall stud. How wide must the jamb be?

Width of jamb = ____________________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #10 — SUBTRACT FRACTIONS

NAME ______________________________ SCORE ______________

Just as concrete masons must frequently add fractions, they must also subtract fractions. Although the dimensions on a blueprint may look nice and even, the actual construction leads to many fractional measurements. For example, a blueprint may show that a door is 2′ −4″ wide. However, the carpenter will leave a rough opening of approximately 2′ −6½″ because the door frame will reduce the opening. Subtraction of fractions is helpful in figuring such reductions.

To subtract common fractions, change to equivalent fractions with common denominators. Find the difference between the numerators of the equivalent fractions. Place the difference over the common denominator and, if necessary, reduce the answer to lowest terms.

EXAMPLE: $\frac{2}{3} - \frac{1}{4}$ becomes $\frac{8}{12} - \frac{3}{12} = \frac{5}{12}$

Subtract each of the common fractions given below. Reduce to lowest terms. Refer to Information Sheet, Section XIII, if necessary.

A. $\frac{3}{4} - \frac{3}{16} =$ ______________

B. $\frac{7}{8} - \frac{1}{4} =$ ______________

C. $\frac{30}{32} - \frac{3}{4} =$ ______________

D. $\frac{25}{32} - \frac{5}{8} =$ ______________

E. $\frac{7}{8} - \frac{2}{16} =$ ______________

F. $\frac{15}{16} - \frac{3}{8} =$ ______________

G. $\frac{1}{2} - \frac{7}{16} =$ ______________

H. $\frac{3}{4} - \frac{3}{8} =$ ______________

I. $\frac{13}{16} - \frac{9}{32} =$ ______________

J. $\frac{7}{8} - \frac{6}{16} =$ ______________

ASSIGNMENT SHEET #10

K. The actual dimensions of a two-by-four board are $1\frac{1}{2}''$ × $3\frac{1}{2}''$. How much difference is there between the stated width and actual width of a two-by-four board?

Difference in width = ____________________

L. The directions for installing dowel rods state that the concrete mason must first drill a hole $\frac{1}{32}$ inch smaller than the diameter of the rod. What diameter hole must be drilled if the concrete mason uses dowel rods with a $\frac{9}{16}$-inch diameter?

Hole diameter = ____________________

M. What is the difference in thickness between $\frac{1}{2}$-inch expansion material and $\frac{5}{8}$-inch expansion material?

Difference in thickness = ____________________

N. A saw blade removes $\frac{1}{64}$ inch of wood for each cut. A board $47\frac{5}{8}$ inches long is cut in two. If one piece is $24\frac{1}{2}$ inches long, how long is the other piece?

Length = ____________________

O. A 12-penny nail is $3\frac{1}{4}$ inches long, not counting the head. If a two-by-four board is actually $1\frac{1}{2}$ inch thick, how much of the nail will extend beyond the board if you drive a 12-penny nail through a two-by-four board?

Length of extended part of nail = ____________________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #11 — MULTIPLY FRACTIONS

NAME ______________________________ SCORE ______________

Multiplying with fractions is often a shortcut for adding fractions; and because concrete masons often add similar fractions, they can multiply to save time. For example, to figure five openings 23 3/4 inches that must be blocked out of a slab, it is much easier to multiply the width by the number of openings rather than to add 23 3/4 inches five times. A good concrete mason quickly learns to appreciate the convenience of being able to multiply fractions when possible.

To multiply fractions, multiply the numerators and denominators separately. Write the product of the numerators over the product of the denominators and reduce to lowest terms.

EXAMPLE: $\frac{2}{3} \times \frac{3}{4}$ becomes $\frac{2 \times 3}{3 \times 4} = \frac{6}{12} = \frac{1}{2}$

Multiply the following fractions. Convert mixed fractions where needed and reduce answers to lowest terms. Refer to Information Sheet, Section XIV, if necessary.

A. $\frac{1}{2} \times \frac{3}{4} =$ ______

B. $\frac{3}{8} \times \frac{5}{16} =$ ______

C. $1\frac{1}{2} \times 2\frac{1}{4} =$ ______

D. $\frac{1}{2} \times 6\frac{1}{2} =$ ______

E. $\frac{7}{8} \times \frac{2}{3} =$ ______

F. $1\frac{1}{3} \times 2\frac{1}{4} \times \frac{1}{2} =$ ______

G. $\frac{1}{4} \times \frac{1}{3} \times \frac{1}{2} =$ ______

H. $2\frac{3}{4} \times 6\frac{1}{8} =$ ______

ASSIGNMENT SHEET #11

I. A porch slopes in such a way that the porch is $1/4$ foot higher for each horizontal foot along the base of the porch. What is the total rise in feet if the porch rises for a distance of $8\,1/2$ feet?

Total rise = ____________________

J. A certain adhesive requires mixing $3/4$ gallon base and $1/4$ gallon hardener to make a gallon of adhesive. How much base should a worker use if she needs to mix only $1/3$ gallon of adhesive?

Amount of base = ____________________

K. There are 296 four-penny nails per pound. How many nails are there in $1/4$ pound?

Number of nails = ____________________

L. After completing an addition of houses, a contractor has $8\ 2/3$ pounds of concrete coloring left in three different colors. If one-half of the coloring is brown, how many pounds of brown coloring are there?

Number of pounds of brown coloring = ____________________

M. A carpenter is installing a lockset in a $1\,3/4$-inch-thick door. He wants to drill a hole in the edge of the door for the strike, and he wants the strike centered on the edge. Where must the hole be drilled if the strike is centered half way across the $1\,3/4$-inch edge?

Hole location = ____________________ from each side of edge

BASIC MATH
UNIT I

ASSIGNMENT SHEET #12 — DIVIDE FRACTIONS

NAME ______________________________ SCORE ______________

Just as concrete masons must be able to multiply fractions to save time, they must also be able to divide fractions. A good concrete mason quickly learns to appreciate the convenience of being able to divide as well as multiply fractions when possible.

To divide fractions, invert the divisor and then multiply the numerators and denominators separately. Write the product of the numerators over the product of the denominators and reduce to lowest terms.

EXAMPLE: $\frac{3}{4} \div \frac{1}{8} = \frac{3}{4} \times \frac{8}{1} = \frac{3 \times 8}{4 \times 1} = \frac{24}{4} = 6$

Divide the following fractions. Convert mixed fractions where needed and reduce answers to lowest terms. Refer to Information Sheet, Section XV, if necessary.

A. $\frac{7}{8} \div \frac{3}{4} =$ ______

B. $\frac{3}{4} \div 2 =$ ______

C. $\frac{5}{6} \div \frac{4}{5} =$ ______

D. $3\frac{1}{2} \div \frac{3}{4} =$ ______

E. $\frac{9}{10} \div \frac{1}{3} =$ ______

F. $7\frac{1}{3} \div \frac{3}{5} =$ ______

G. $\frac{3}{8} \div \frac{1}{2} =$ ______

H. $8 \div \frac{3}{5} =$ ______

I. $12\frac{3}{8} \div 1\frac{1}{2} =$ ______

J. $2\frac{2}{3} \div \frac{1}{16} =$ ______

BASIC MATH
UNIT I

ASSIGNMENT SHEET #13 — ADD DECIMAL NUMBERS

NAME ______________________________ SCORE ______________

As a consumer of raw materials, a concrete mason often needs to calculate the costs of concrete slabs. Such costs are figured in dollars and cents. But cents are only decimal parts of a dollar, and every time concrete masons or anyone else totals the cost of a purchase, they are adding decimals.

You can add decimals just as you add whole numbers. You must be careful, though, to keep all decimal points aligned.

Add each column of numbers, carrying when necessary. Place a decimal point in the answer directly under the decimal points above. Refer to Information Sheet, Section XVII, if necessary.

EXAMPLES:

0.26
+ 0.168
0.428

$4.60
+ .40
$5.00

A.
0.024
+ 0.165

B.
0.873
+ 0.199

C.
$4.60
+ 4.62

D.
0.0003
+ 0.0099

E.
$62.14
+ 8.87

F.
$34.87
+ 96.45

G.
195.7
83.
+ 9.006

H.
0.0131
0.1640
+ 0.2229

I.
4.612
0.958
+ 0.885

J.
4937.23
4980.47
10234.97
+ 9872.21

K.
15.125
4.625
20.125
+ 16.125

L.
0.52802
0.34007
0.00321
+ 0.00009

ASSIGNMENT SHEET #13

M. A contractor bought some roofing materials and spent $141.72 for shingles, $16.81 for felt paper, and $6.27 for flashing. What was the total cost of the roofing materials?

Total cost = ____________________

N. A concrete finisher worked four days for a certain contractor. She worked 6.8 hours Monday, 7.4 hours Tuesday, 9.3 hours Wednesday, and 4.4 hours Thursday. How many total hours did she work for the contractor?

Total hours worked = ____________________

O. How much was spent on tools if a concrete mason bought the tools below at the prices listed?

Concrete grinder	$95.88
Hand level	$9.95
Piece of keel	39¢
Chipping hammer	$6.49
Sledge hammer	$10

Total cost = ____________________

P. For tax purposes, a concrete mason must keep track of mileage driven in the line of work. During the past quarter, he drove 386.4 miles the first month, 519 miles the second month, and 461.2 miles the third month. What was his total mileage for the quarter?

Total mileage = ____________________

ASSIGNMENT SHEET #13

Q. A contractor is interested in building energy-efficient houses and would like to advertise the insulation values of his houses. To do this, he must figure the thermal resistance (R) value for the structure. For the exterior walls he uses the materials given below with the R values stated. What is the total R value of these materials?

Material	**R-Value**
Brick, 3"	0.60
Vapor barrier	0.84
Foil-wrapped polystyrene siding	6.25
Blown fiberglass	18.41
Drywall, 1/2"	0.45

Total R value = ____________________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #14 — SUBTRACT DECIMAL NUMBERS

NAME ______________________________ SCORE ____________

Decimals are a part of our daily lives, not only in figuring money but also in calculating time, distance, area, and many other quantities. In the concrete trade, decimals are becoming more common, especially with the increased use of metric measurements. Subtraction is one of the basic mathematical operations done with decimals in the trade.

Set up each of the following problems in column form. Subtract and check your work. Remember, when you subtract decimals, the decimal points must be aligned. Refer to Information Sheet, Section XVIII, if necessary.

A. 868.87 – 516.89 = ____________________

B. 567 – 19.856 = ____________________

C. 198 – 56.987 = ____________________

D. 567.94 – 59.78 = ____________________

E. $815.23 – $65.98 = ____________________

ASSIGNMENT SHEET #14

F. $20.03 − $15.88 = ____________________

G. 694.7 − 24.3 = ____________________

H. 5000 − 892.66 = ____________________

I. $15 − $12.53 = ____________________

J. $219.30 − $21.85 = ____________________

K. A concrete mason keeps track of mileage driven on the job. At the beginning of the month, the vehicle odometer reads 29,268.4. At the end of the month, the odometer reads 29,872.1. How many miles were driven during the month?

Miles driven for month = ____________________

L. A concrete mason completed a remodeling project and computed her profit. She was paid $6500.00 for the project. How much profit did she make if her expenses were $4718.96?

Profit = ____________________

ASSIGNMENT SHEET #14

M. A carpenter has been using 12-gauge and 14-gauge flashing. In order to determine what screws to use to install skylights, she must know the difference in thickness of the two gauges. What is the difference if 12-gauge is 0.0808 inch thick and 14-gauge is 0.0641 inch thick?

Difference in thickness = ______________________

N. A concrete mason bought plywood on sale. He had estimated the cost to be $1238.62 based on the regular price. How much did he save if the cost on sale was $1061.19?

Savings = ______________________

O. A floor plan has 1781 square feet of living space. A change is made to the plan, reducing the living space by 264.5 square feet. What is the area of the modified plan?

Area of modified plan = ______________________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #15 — MULTIPLY DECIMAL NUMBERS

NAME ______________________________ SCORE ______________

Concrete masons work with many geometric shapes and are often required to calculate the area of such shapes. The formulas used in computing the areas of shapes often require multiplying by decimals, such as in using 3.14 to figure the area of a circle. Additionally, costs and earnings may be calculated by multiplying with decimals—an essential skill for any good concrete mason.

Multiplication with decimals is similar to multiplication with whole numbers. However, with decimals you must take care in placing the decimal point correctly. The number of decimal places in an answer must equal the total number of decimal places in the numbers that you multiplied.

EXAMPLE:

$$\begin{array}{rl} 16.11 & \text{2 Decimal Places} \\ \times\ \ 2.2 & \text{1 Decimal Place} \\ \hline 3222 & \\ 3222 & \\ \hline 35.442 & \text{3 Decimal Places in Answer} \end{array}$$

Set up each of the following problems in column form and multiply. Locate the decimal point in the answer. Refer to Information Sheet, Section XIX, if necessary.

A. 2.64 × 3.1 = ____________________

B. 120 × 0.33 = ____________________

ASSIGNMENT SHEET #15

C. 2.25 × 0.51 = ____________________

D. 35 × 8.5 = ____________________

E. 26.4 × 3.8 = ____________________

F. 7.02 × 0.92 = ____________________

G. 0.83 × 0.55 = ____________________

ASSIGNMENT SHEET #15

H. 28.2 × 0.9 = ____________________

I. 0.069 × 0.01 = ____________________

J. 7.52 × 3.01 = ____________________

K. A concrete saw is placed on sale for 25 percent off. How much is the price reduced if the regular price is $1349.80?

(NOTE: Twenty-five percent is the same as the decimal 0.25.)

Price reduction = ____________________

ASSIGNMENT SHEET #15

L. The average cost per square foot of houses in a certain area is $41.25. What would be the approximate cost of a 1500-square-foot house?

Approximate cost = ____________________

M. A building code specifies a maximum grade for driveways of 33.3 percent, which means that the maximum slope for a driveway 100 feet in length would be 33.3 feet. How much slope would be allowed for a lot 75 feet deep?

Slope = ____________________

N. A concrete mason buys 38 pairs of kneeboards at a cost of $3.49 each pair. What is the total cost?

Total cost = ____________________

O. If the average weight of terrazzo is 2.5 pounds per square foot, what is the total weight of the terrazzo on a 831.75-square-foot area?

Total weight = ____________________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #16 — DIVIDE DECIMAL NUMBERS

NAME ______________________________ SCORE ______________

A concrete mason will usually have to shop around to find the best buys in tools and materials. Price comparisons often become difficult because not all suppliers base their prices on the same unit. For example, one supplier may price expansion material by the sheet while another quotes costs as so much a square foot. Being able to divide decimal numbers will help a concrete mason determine the best buys. Division with decimal numbers is also useful in figuring quantities of materials, weighing job opportunities, and in many other aspects of the trade.

Division with decimals is like division with whole numbers. However, before you begin to divide, you must decide where the decimal point should be placed in the number.

First study the divisor. If it has a decimal, move the decimal point to the right so that you change the decimal to a whole number. Then move the decimal point the same number of places to the right in the original number (number into which you are dividing).

EXAMPLE 1: Decimal point moved one place in both numbers.

$\underset{\curvearrowright}{.2.}\,\overline{)\underset{\curvearrowright}{.4.}}$

$$\begin{array}{r} 2. \\ 2.\,\overline{)4.} \\ \underline{4} \\ 0 \end{array}$$

EXAMPLE 2: Decimal point moved two places in both numbers.

$\underset{\curvearrowright}{.14.}\,\overline{)\underset{\curvearrowright}{.14.}028}$

$$\begin{array}{r} 1.002 \\ 14.\,\overline{)14.028} \\ \underline{14} \\ 0\ 028 \\ \underline{28} \\ 0 \end{array}$$

EXAMPLE 3: Decimal point moved one place in both numbers; note that a zero had to be added.

$\underset{\curvearrowright}{1.3.}\,\overline{)\underset{\curvearrowright}{26.0.}}$

$$\begin{array}{r} 20. \\ 13.\,\overline{)260.} \\ \underline{26} \\ 00 \end{array}$$

EXAMPLE 4: No decimal point was moved to the right because 3 is already a whole number.

$3\,\overline{).6}$

$$\begin{array}{r} .2 \\ 3\,\overline{).6} \\ \underline{6} \\ 0 \end{array}$$

ASSIGNMENT SHEET #16

Divide numbers in the following problems. Show your work. Refer to Information Sheet, Section XX, if necessary, and check your answers.

A. 4.5 ÷ 0.5 = ____________________

B. 4.96 ÷ 0.4 = ____________________

C. 19.8 ÷ 0.6 = ____________________

D. 10.71 ÷ 0.07 = ____________________

E. 0.225 ÷ 0.15 = ____________________

F. 1.7608 ÷ 0.0062 = ____________________

G. 0.48 ÷ 0.6 = ____________________

ASSIGNMENT SHEET #16

H. 0.125 ÷ 0.25 = ____________________

I. 0.9 ÷ 0.003 = ____________________

J. 1.16 ÷ 2.9 = ____________________

K. 75 ÷ 0.03 = ____________________

L. 108 ÷ 0.09 = ____________________

M. 84 ÷ 0.007 = ____________________

N. 459 ÷ 2.7 = ____________________

ASSIGNMENT SHEET #16

O. 406 ÷ 0.029 = ____________________

P. What is the approximate cost per bag of cement if the cost of twelve bags is $103.68?

Approximate cost = ____________________

Q. How many hours did a concrete mason work if she was paid a total of $681.75 at the rate of $22.50 per hour?

Total hours = ____________________

R. How many lots can be platted on a 21.12-acre addition if the average lot is 0.66 acres?

Number of lots = ____________________

S. A concrete mason spent $172.80 for aluminum straightedges. What was the cost per straightedge if he bought eight straightedges?

Cost per straightedge = ____________________

T. If it takes a concrete mason 12.6 hours to lay a 1680-square-foot roof, how long does it take to lay 100 square feet of roof?

Length of time = ____________________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #17 — CONVERT FRACTIONS AND PERCENTAGES

NAME ______________________________ SCORE ____________

In concrete work, percentage is often useful. *Percent* means "per hundredths." Five percent means five one-hundredths and may be written three ways: $^{5}/_{100}$, 0.05, and 5%. All have the *same* mathematical value.

Complete the following exercises. Refer to Information Sheet, Sections XXI through XXIII, if necessary.

PART I

A. Express each of the following fractions as a decimal.

1. $^{1}/_{8}$ = __________
2. $^{1}/_{4}$ = __________
3. $^{1}/_{2}$ = __________
4. $^{3}/_{4}$ = __________
5. $^{5}/_{8}$ = __________
6. $^{1}/_{16}$ = __________
7. $^{3}/_{32}$ = __________
8. $^{7}/_{8}$ = __________
9. $^{9}/_{16}$ = __________
10. $^{15}/_{16}$ = __________

B. Express each of the following fractions as a percentage.

1. $^{1}/_{4}$ = __________
2. $^{1}/_{2}$ = __________
3. $^{7}/_{10}$ = __________
4. $^{3}/_{4}$ = __________
5. $^{2}/_{2}$ = __________

ASSIGNMENT SHEET #17

6. $^{1}/_{10}$ = ____________

7. $^{7}/_{8}$ = ____________

8. $^{5}/_{10}$ = ____________

9. $^{1}/_{3}$ = ____________

10. $^{5}/_{8}$ = ____________

PART II

Fractions having denominators of ten, or one of the powers of ten (place values), are easily written as decimal numbers. Simply allow as many places to the right of the decimal point as there are zeros in the denominator.

EXAMPLES:	$1^{5}/_{10} = 1.5$	tenths
	$1^{25}/_{100} = 1.25$	hundredths
	$1^{125}/_{1000} = 1.125$	thousandths

A. Match the decimal numbers on the right to their correct equivalent fractions. Write the correct letters in the blanks.

______ 1. $5\,^{6}/_{10}$

______ 2. $1\,^{2}/_{100}$

______ 3. $^{87}/_{1000}$

______ 4. $7\,^{83}/_{1000}$

______ 5. $5\,^{6}/_{100}$

______ 6. $5\,^{6}/_{1000}$

______ 7. $78\,^{3}/_{10}$

______ 8. $87\,^{7}/_{10}$

______ 9. 102

______10. $^{783}/_{1000}$

a. 7.083
b. 5.006
c. 78.3
d. 0.087
e. 0.783
f. 87.7
g. 5.6
h. 102.0
i. 5.06
j. 1.02

ASSIGNMENT SHEET #17

B. Write decimal equivalents for each of the following fractions.

1. $63\frac{9}{10}$ = __________
2. $5\frac{93}{100}$ = __________
3. $5\frac{93}{1000}$ = __________
4. $5\frac{93}{10000}$ = __________
5. $3\frac{825}{1000}$ = __________
6. $38\frac{95}{100}$ = __________
7. $38\frac{95}{1000}$ = __________
8. $42\frac{3}{10}$ = __________
9. $402\frac{3}{10}$ = __________
10. $897\frac{97}{100000}$ = __________

PART III

A. Express each of the following percentages as a fraction. Reduce to lowest terms.

1. 50% = __________
2. 25% = __________
3. $33\frac{1}{3}$% = __________
4. 36% = __________
5. 28% = __________
6. $14\frac{2}{7}$% = __________
7. 21% = __________
8. 75% = __________
9. $66\frac{2}{3}$% = __________
10. 70% = __________

B. Express each of the following percentages as a decimal.

1. 47% = __________
2. 15% = __________
3. 33.3% = __________
4. 62% = __________
5. 75% = __________
6. 3% = __________
7. 16.8% = __________
8. 9% = __________
9. 10% = __________
10. 50% = __________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #18 — SOLVE PERCENTAGE PROBLEMS

NAME ________________________________ SCORE ______________

In the concrete field, you will frequently come across percentages. Interest rates, pricing discounts, waste allowances, the rise or decline of housing starts, and many other factors that affect the industry are stated as percentages. To make the most of your career in this field, you must understand what percentages mean and how they are used.

Solve the following percentage problems. Refer to Information Sheet, Section XXIV, if necessary.

PART I

A. What does it mean to say 100 percent of the work is completed? ______________

____

B. There are usually 100 tools in the tool shed. Fourteen of them are missing. What percent of the tools are missing? ______________________________

C. If 14 of the tools are missing in the above problem, how many are present? __________

What percent are present? ______________________________

D. There are 100 stakes in a stack. Twenty-five stakes are what percent of the stakes in the stack? ______________________________

Five stakes are what percent of the stakes in the stack? ______________

ASSIGNMENT SHEET #18

E. There are 100 jobs on the agenda. Ninety-four have been completed. What percent of the jobs have been completed? ____________________

F. If 94 of the jobs in the above problem have been completed, how many have not been?

____

What percent have not been completed? ____________________

G. If 11 percent of the students in a school are absent, what percent are present? ________

H. If 6 percent of the hand saws that a store had in stock were not sold, what percent were sold?____________________

I. If 60 percent of the concrete masons in town had cards, what percent did not have cards?

____

J. Bill has a set of concrete tools. Ten percent of his tools are a year old, and 40 percent are over a year old. What percent are less than a year old? ____________________

ASSIGNMENT SHEET #18

K. Susan has three types of trowels—finish, margin, and plastering. Eighty percent of her trowels are finish, and 15 percent are plastering. What percent are margin? __________

L. The Smiths spent 22 percent of their income for their business, 17 percent for tools, 15 percent for work clothes, and 8 percent for entertainment. What percent was left for other things? ______________________________

M. Chester has finished 75 percent of the job he is doing. What percent does he still have to do?______________________________

N. Betty has completed 40 percent of her training. What percent does she still have to do?

____

O. If you were told to complete 93 percent of the work, what percent would be left?

____

ASSIGNMENT SHEET #18

PART II

Solve each of the following percentage problems.

A. 3% of 72 is what number? ___________

B. 5% of 18 is what number? ___________

C. What number is $33\frac{1}{3}\%$ of 96? ___________

D. 40% of 125 is what number? ___________

E. 68% of 63.5 is what number? ___________

F. What number is $12\frac{1}{2}\%$ of 140.8? ___________

G. What number is 1% of 103? ___________

H. What number is $37\frac{1}{2}\%$ of 152? ___________

I. 50% of 32.8 is what number? ___________

J. 7% of 163 is what number? ___________

ASSIGNMENT SHEET #18

PART III

Solve the following percentage word problems. Show your work.

A. There are 20 students in a class. Sixty percent of the students are boys.

How many are boys? ___________

B. One day 5 percent of the 20 concrete masons in Mr. Moore's group made perfect time completing a job. How many concrete masons made perfect time? ___________

C. Contractor McGill bought a new bull float—regularly selling for $120—at a sale and saved 20 percent. How much money did he save? ___________

D. The number of concrete masons at the meeting this week was 75 percent of what it was last week. Last week there were 800 concrete masons at the meeting. How many concrete masons were at the meeting this week? ___________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #19 — CALCULATE AREA

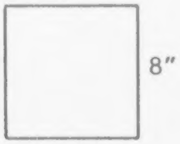
NAME ______________________________ SCORE ______________

One of the most common mathematical operations in estimating concrete materials is the calculation of area. You must figure area for floor slabs, walls, steps, sidewalks, driveways, parking lots, curbs, curbs and gutters, and many other areas of construction. In fact, the basic pricing unit in the industry is figured on the area of a structure. Therefore, to understand the costs of materials and construction, you must learn to calculate area.

Calculate area for the following problems. Refer to Information Sheet, Section XXVIII, if necessary.

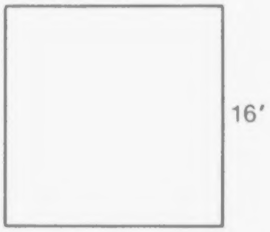
A. Calculate the area for each of the following squares.

1.



A = ______________________

2.



A = ______________________

3. Square = 15 feet

A = ______________________

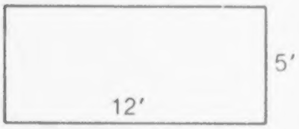
4. Square = 36 yards

A = ______________________

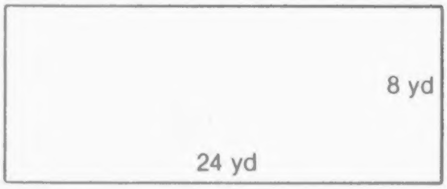
ASSIGNMENT SHEET #19

B. Calculate area for each of the following rectangles.

1.



2.



A = ______________________________

A = ______________________________

3. L = 17″; W = 31″

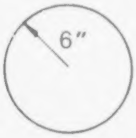
4. L = 16′; W = 62′

A = ______________________________

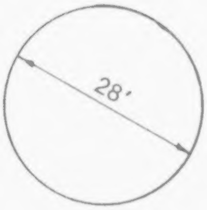
A = ______________________________

C. Calculate area for each of the following circles. (Use $\pi = 3.14$.)

1.



2.



A = ______________________________

A = ______________________________

ASSIGNMENT SHEET #19

3. Radius = 16′

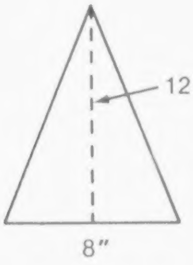
4. Diameter = 25 yards

A = ______________________________

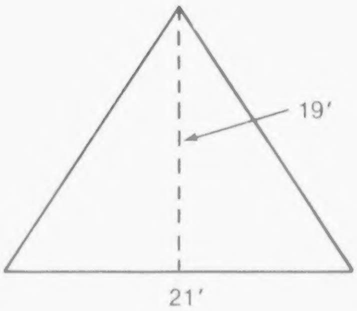
A = ______________________________

D. Calculate area for each of the following triangles.

1.



2.



A = ______________________________

A = ______________________________

3. b = 13″; h = 3″

4. b = 24 yards; h = 15 yards

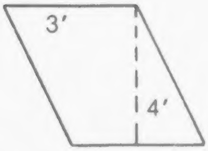
A = ______________________________

A = ______________________________

ASSIGNMENT SHEET #19

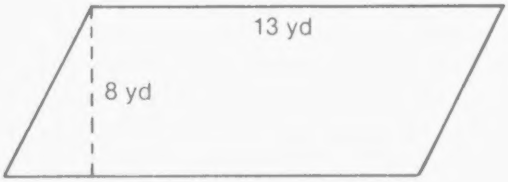
E. Calculate area for each of the following parallelograms.

1.



A = ____________________

2.



A = ____________________

3. b = 16″; h = 16″

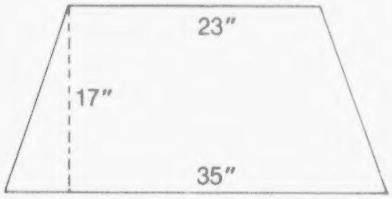
A = ____________________

4. b = 27 yards; h = 9 yards

A = ____________________

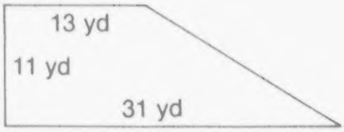
F. Calculate area for each of the following trapezoids.

1.



A = ____________________

2.


13 yd
11 yd
31 yd

A = ____________________

ASSIGNMENT SHEET #19

3. $H = 12'$; $B_1 = 9'$; $B_2 = 19'$

4. $H = 17$ yards; $B_1 = 39$ yards; $B_2 = 51$ yards

A = ______________________________

A = ______________________________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #20 — CALCULATE VOLUME

NAME ______________________________ SCORE ______________

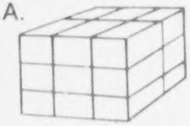
Concrete masons should be familiar with volumetric measurements in order to make estimates and to use materials wisely. One of the most common uses of cubic volume measurements is in estimating concrete. Volumetric measurements can be used to estimate concrete for walls, steps, floor slabs, and they are also used by other crafts and other construction-related systems. A good concrete mason must be familiar with how volume is determined.

PART I

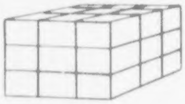
Record the dimensions and volume for the figures below this chart. Remember that volume is the number of cubic units. Refer to Information Sheet, Section XXIX, if necessary.

	Height = H	Width = W	Length = L	Volume = V
A.				
B.				
C.				
D.				
E.				
F.				
G.				
H.				
I.				
J.				

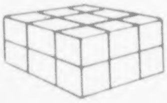
A.



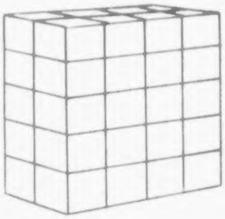
B.



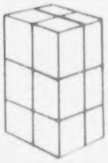
C.



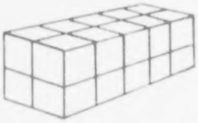
D.



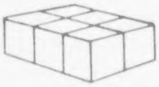
E.



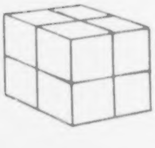
F.



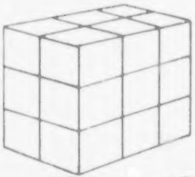
G.



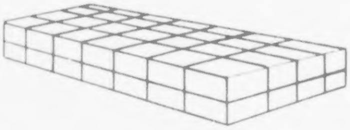
H.



I.



J.



ASSIGNMENT SHEET #20

PART II

Answer the following questions about the boxes illustrated.

____________________A. How many cubes are there in Box #1?

____________________B. How many cubes are still needed to fill the bottom layer of Box #1?

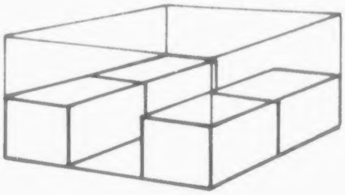
____________________C. How many layers can Box #1 hold inside?

____________________D. How many cubes are needed for the top layer in Box #1?

____________________E. How many total cubes would there be if Box #1 were full?

____________________F. What is the volume of Box #1?

Box #1

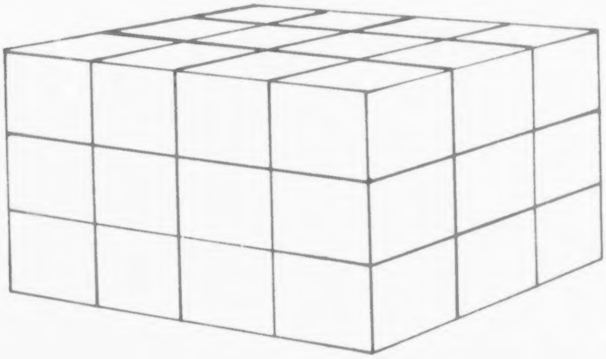


____________________G. How many cubes are there in the bottom layer of Box #2?

____________________H. How many layers are there in Box #2?

____________________I. What way can volume be figured for Box #2 *without counting* each of the cubes?

Box #2



ASSIGNMENT SHEET #20

______________________ J. How many cubic inches in 1 cubic foot? (Think of stacking cubic inches in Box #3.)

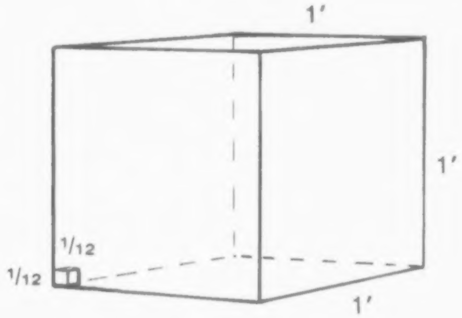
______________________ K. How many cubic inches would it take to fill one layer in Box #3?

______________________ L. How many cubic inches would it take to fill two layers in Box #3?

______________________ M. How many cubic inches would it take to fill three layers in Box #3?

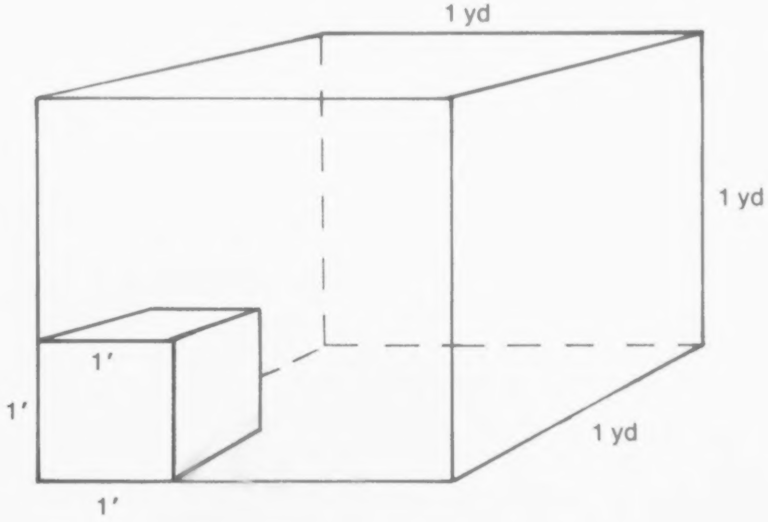
______________________ N. How many layers would it take to fill Box #3?

Box #3



______________________ O. How many cubic feet in 1 cubic yard? (Think of stacking cubic feet in Box #4.)

Box #4

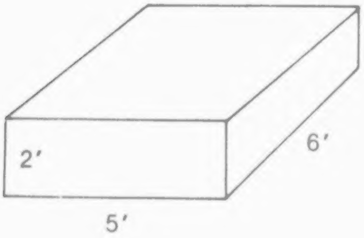


ASSIGNMENT SHEET #20

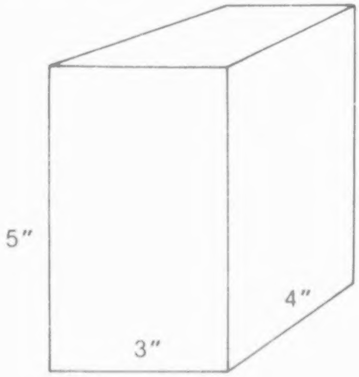
PART III

Use the formula V = LWH to calculate volume for the following figures.

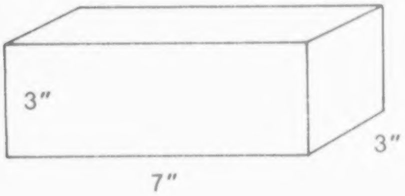
A. V = ____________________



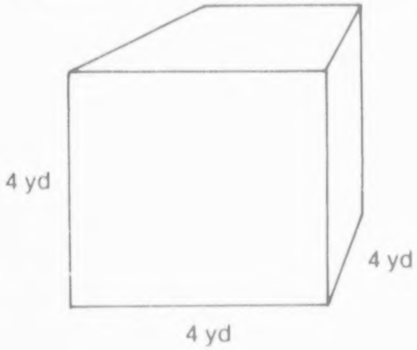
D. V = ____________________



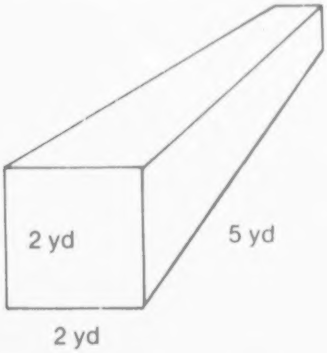
B. V = ____________________



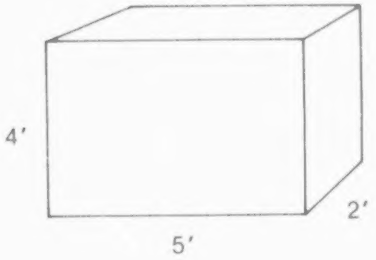
E. V = ____________________



C. V = ____________________



F. V = ____________________



BASIC MATH
UNIT I

ASSIGNMENT SHEET #21 — ESTIMATE CUBIC YARDS

NAME ______________________________ SCORE ____________

Concrete masons often have to compute cubic yard measurements to estimate materials and labor. Cubic yards is the basic unit of measurement for concrete and other materials. Therefore, a concrete mason must be able to calculate cubic yard measurements accurately.

Solve the following problems involving cubic yards. Refer to Information Sheet, Section XXIX, if necessary.

A. How many cubic yards of concrete will it take for a driveway 20 feet wide by 72 feet long by 4 inches thick?

Total cubic yards = ____________________

B. Find the total cubic yards of concrete it will take to fill a cavity wall if the cavity is 8 feet high, 22 feet long, and 6 inches thick?

Total cubic yards = ____________________

C. How many cubic yards of grout will it take to fill a cavity 12 feet high, 37 feet long, and 3 inches thick?

Total cubic yards = ____________________

D. Find the total cubic yards of sand it will take to fill a swimming pool 34 feet wide, 45 feet long, and 4 inches thick?

Total cubic yards = ____________________

E. How many cubic yards of concrete will it take to pour a sidewalk 6 feet wide, 118 feet long, and 4 inches thick?

Total cubic yards = ____________________

BASIC MATH
UNIT I

ASSIGNMENT SHEET #22 — SOLVE BASIC RATIO AND PROPORTION PROBLEMS

NAME ______________________________ SCORE ______________

The concrete masonry trade uses more ratios and proportions today than ever before. New mastics, epoxy resins, and bonding agents often require mixing. Ratios are used to designate grade slopes and relationships such as heat loss and load-bearing capacities. The concrete mason will be required to calculate some ratios and proportions, and will be required to apply many others.

Solve the following ratio and proportion problems. Refer to Information Sheet, Section XXX, if necessary. Show your work.

A. Convert the ratio 0.25:0.25:1 to the smallest proportion possible containing whole numbers.

Proportion = ______________

B. What would be the proportion if a 1:2:12 mix were cut in half?

Proportion = ______________

C. What would be the proportion if the ratio 1:1:3 were tripled?

Proportion = ______________

D. You are asked to mix a batch of topping using a 1:1:6 ratio, but you will need six times this amount. What will be the proportion of material needed?

Proportion = ______________

E. A mixture of 1 part cement, 1 part pea gravel, and 3 parts sand is needed to make 25 cubic feet of topping. How many cubic feet of each are needed?

Cubic feet cement = ______________

Cubic feet pea gravel = ______________

Cubic feet sand = ______________

BASIC MATH
UNIT I

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

PART I

A. 11
B. 16
C. 13
D. 23
E. 108
F. 88
G. 242
H. 1538
I. 1917
J. 16,430

PART II

A. 1175 lineal feet
B. 1135 doors
C. $609
D. 12,130 square feet

Assignment Sheet #2

PART I

A. 4
B. 7
C. 53
D. 406
E. 424
F. 283
G. 1175
H. 1810
I. 51,450
J. 89,722

PART II

A. 126 two-by-fours
B. 1160 square feet
C. 4410 square feet
D. 14,145 curb clamps

Assignment Sheet #3

PART I

A. 42
B. 72
C. 324
D. 2884
E. 8410
F. 2028
G. 21,291
H. 165,478
I. 503,605
J. 5,458,852

PART II

A. 68,383 pounds
B. 8160 square feet
C. 2850 square feet
D. 1440 hours

Assignment Sheet #4

PART I

A. 4
B. 8
C. 91
D. 312
E. 3
F. 3
G. 62, R 4
H. 2, R 97
I. 1, R 365
J. 3, R 634

PART II

A. 2070 square feet
B. 8 windows, 4 inches
C. 975 square feet of colored concrete
D. 68 sheets

Assignment Sheet #5

PART I

A. 1. 5,8
   2. numerator, denominator
   3. 1,4

B. 1. $^{10}/_{16}$
   2. $^{16}/_{32}$

C. 1. 1
   2. 8
   3. $^{1}/_{8}$

ANSWERS TO ASSIGNMENT SHEETS

PART II

A. 1. n
2. d
3. f
4. k
5. a
6. j
7. i
8. l
9. b
10. g
11. m
12. c
13. h
14. o
15. e

B. Evaluated to the satisfaction of the instructor

Assignment Sheet #6

A. 1/2
B. 1/2
C. 1
D. 1/4
E. 1/4
F. 3/8
G. 1/2
H. 1/2
I. 3/4
J. 1/2

Assignment Sheet #7

PART I

A. 4
B. 8
C. 3
D. 5
E. 3
F. 20
G. 18
H. 9
I. 6
J. 28
K. 3
L. 7

PART II

A. 6/16 and 8/16
B. 96/128 and 36/128
C. 8/128 and 80/128
D. 16/32 and 14/32
E. 1536/2048 and 1152/2048 and 448/2048

PART III

A. 6/20 and 5/20
B. 32/48 and 9/48
C. 24/32 and 9/32
D. 8/16 and 7/16
E. 30/40 and 25/40 and 28/40

Assignment Sheet #8

PART I

A. 1. P
2. M
3. I
4. M
5. P
6. I
7. I
8. M
9. I
10. M
11. M
12. I
13. I
14. P
15. M

B. Evaluated to the satisfaction of the instructor

C. Evaluated to the satisfaction of the instructor

PART II

A. 1. 13/4
2. 9/2
3. 31/4
4. 17/2
5. 49/8
6. 11/2
7. 17/4
8. 19/2
9. 37/4
10. 33/2

B. 1. $1\frac{3}{4}$
2. $4\frac{1}{2}$
3. $1\frac{1}{2}$
4. $1\frac{7}{8}$
5. $1\frac{3}{16}$
6. $1\frac{3}{8}$
7. $2\frac{11}{32}$
8. $2\frac{1}{2}$
9. $3\frac{3}{4}$
10. $2\frac{1}{16}$

Assignment Sheet #9

A. 1/2
B. 1
C. 23/32
D. $1\frac{3}{16}$
E. 29/32
F. $1\frac{3}{16}$
G. $1\frac{5}{16}$
H. $1\frac{25}{32}$
I. 5/8 gallon
J. $1\frac{3}{32}$ inches
K. $2\frac{1}{3}$ squares
L. $1\frac{3}{16}$ inches
M. $5\frac{1}{4}$ inches

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #10

A. $^{9}/_{16}$
B. $^{5}/_{8}$
C. $^{3}/_{16}$
D. $^{5}/_{32}$
E. $^{3}/_{4}$
F. $^{9}/_{16}$
G. $^{1}/_{16}$
H. $^{3}/_{8}$
I. $^{17}/_{32}$
J. $^{1}/_{2}$
K. $^{1}/_{2}$ inch
L. $^{17}/_{32}$ inch
M. $^{1}/_{8}$ inch
N. $23^{7}/_{64}$ inches
O. $1^{3}/_{4}$ inches

Assignment Sheet #11

A. $^{3}/_{8}$
B. $^{15}/_{128}$
C. $3^{3}/_{8}$
D. $3^{1}/_{4}$
E. $^{7}/_{12}$
F. $1^{1}/_{2}$
G. $^{1}/_{24}$
H. $16^{27}/_{32}$
I. $2^{1}/_{8}$ feet
J. $^{1}/_{4}$ gallon
K. 74 nails
L. $4^{1}/_{3}$ pounds
M. $^{7}/_{8}$ inch

Assignment Sheet #12

A. $1\,^{1}/_{6}$
B. $^{3}/_{8}$
C. $1\,^{1}/_{24}$
D. $4\,^{2}/_{3}$
E. $2\,^{7}/_{10}$
F. $12^{2}/_{9}$
G. $^{3}/_{4}$
H. $13\,^{1}/_{3}$
I. $8\,^{1}/_{4}$
J. $42\,^{2}/_{3}$

Assignment Sheet #13

A. 0.189
B. 1.072
C. $9.22
D. 0.0102
E. $71.01
F. $131.32
G. 287.706
H. 0.4000
I. 6.455
J. 30024.88
K. 56.000
L. 0.87139
M. $164.80
N. 27.9 hours
O. $122.71
P. 1366.6 miles
Q. 26.55 R

Assignment Sheet #14

A. 351.98
B. 547.144
C. 141.013
D. 508.16
E. $749.25
F. $4.15
G. 670.4
H. 4107.34
I. $2.47
J. $197.45
K. 603.7 miles
L. $1781.04
M. 0.0167 inch
N. $177.43
O. 1516.5 square feet

Assignment Sheet #15

A. 8.184
B. 39.6
C. 1.1475
D. 297.5
E. 100.32
F. 6.4584
G. 0.4565
H. 25.38
I. 0.00069
J. 22.6352
K. $337.45
L. $61,875.00
M. 24.975 feet
N. $132.62
O. 2079.375 pounds

Assignment Sheet #16

A. 9
B. 12.4
C. 33
D. 153
E. 1.5
F. 284
G. 0.8
H. 0.5
I. 300
J. 0.4
K. 2500
L. 1200
M. 12,000
N. 170
O. 14,000
P. $8.64
Q. 30.3 hours
R. 32 lots
S. $21.60
T. 0.75 hour

Assignment Sheet #17

PART I

A.
1. 0.125
2. 0.25
3. 0.5
4. 0.75
5. 0.625
6. 0.0625
7. 0.09375
8. 0.875
9. 0.5625
10. 0.9375

B.
1. 25%
2. 50%
3. 70%
4. 75%
5. 100%
6. 10%
7. 87.5%
8. 50%
9. 33.3%
10. 62.5%

PART II

A.
1. g
2. j
3. d
4. a
5. i
6. b
7. c
8. f
9. h
10. e

ANSWERS TO ASSIGNMENT SHEETS

B.
1. 63.9
2. 5.93
3. 5.093
4. 5.0093
5. 3.825
6. 38.95
7. 38.095
8. 42.3
9. 402.3
10. 897.00097

PART III

A.
1. 1/2
2. 1/4
3. 1/3
4. 9/25
5. 7/25
6. 1/7
7. 21/100
8. 3/4
9. 2/3
10. 7/10

B.
1. 0.47
2. 0.15
3. 0.333
4. 0.62
5. 0.75
6. 0.03
7. 0.168
8. 0.09
9. 0.10
10. 0.50

Assignment Sheet #18

PART I

A. All work is completed
B. 14%
C. 86, 86%
D. 25%, 5%
E. 94%
F. 6, 6%
G. 89%
H. 94%
I. 40%
J. 50%
K. 5%
L. 38%
M. 25%
N. 60%
O. 7%

PART II

A. 2.16
B. 0.9
C. 31.99
D. 50
E. 43.18
F. 17.6
G. 1.03
H. 57
I. 16.4
J. 11.41

PART III

A. 12
B. 1
C. $24.00
D. 600

Assignment Sheet #19

A.
1. 64 square inches
2. 256 square feet
3. 225 square feet
4. 1296 square yards

B.
1. 60 square feet
2. 192 square yards
3. 527 square inches
4. 992 square feet

C.
1. 113.04 square inches
2. 615.44 square feet
3. 803.84 square feet
4. 490.625 square yards

D.
1. 48 square inches
2. 199.5 square feet
3. 19.5 square inches
4. 180 square yards

E.
1. 12 square feet
2. 104 square yards
3. 256 square inches
4. 243 square yards

F.
1. 493 square inches
2. 242 square yards
3. 168 square feet
4. 765 square yards

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #20

PART I

(NOTE: Answers may be reversed in the width and length columns.)

	H	W	L	V
A.	3	3	2	18
B.	3	3	3	27
C.	2	3	3	18
D.	5	2	4	40
E.	3	2	2	12
F.	2	2	5	20
G.	1	2	3	6
H.	2	2	2	8
I.	3	2	3	18
J.	2	4	7	56

PART II

A. 4 cubes
B. 2 cubes
C. 2 layers
D. 6 cubes
E. 12 cubes
F. 12 cubic units
G. 12 cubes
H. 3 layers
I. Answers will vary
J. 1728 cubic inches
K. 144 cubic inches
L. 288 cubic inches
M. 432 cubic inches
N. 12 layers
O. 27 cubic feet

PART III

A. 60 cubic feet
B. 63 cubic inches
C. 20 cubic yards
D. 60 cubic inches
E. 64 cubic yards
F. 40 cubic feet

Assignment Sheet #21

(NOTE: Answers vary slightly depending on method used to make computations.)

A. 17.77 or 17.60 cubic yards
B. 3.259 or 3.52 cubic yards
C. 4.11 cubic yards
D. 18.88 or 18.70 cubic yards
E. 8.74 or 8.65 cubic yards

Assignment Sheet #22

A. 1:1:4
B. 0.5:1:6
C. 3:3:9
D. 6:6:36
E. 5 cubic feet cement
5 cubic feet lime
15 cubic feet sand

FCCM - 137-B

BASIC MATH
UNIT I

TEST

NAME ______________________________ SCORE ______________

1. Match to their correct definitions terms associated with basic math. Write the correct numbers in the blanks.

_____a. To solve by mathematical process

_____b. Process of totaling two or more numbers to find another number called a *sum*

_____c. Fraction with an unwritten denominator of 10 or some power of 10; indicated with a point before the number

_____d. Any one of the ten symbols, 0 to 9, by which all numbers can be expressed

_____e. Opposite (inverse) operation of multiplication

_____f. Part of a whole; represents one or more equal parts of a unit

_____g. Any of the natural numbers, both positive and negative, that represents a complete item

_____h. Pertaining to nominal units based on a 4-inch module

_____i. Abbreviated process of adding a number to itself a specified number of times

_____j. Theoretical size that may vary from the actual

_____k. One part in a hundred; reckoned on the basis of a whole divided into one hundred parts

_____l. Mathematical proposition

_____m. Being relatively equal in size or quantity

_____n. Relationship in quantity, amount, or size between two or more things

_____o. Opposite (inverse) operation of addition

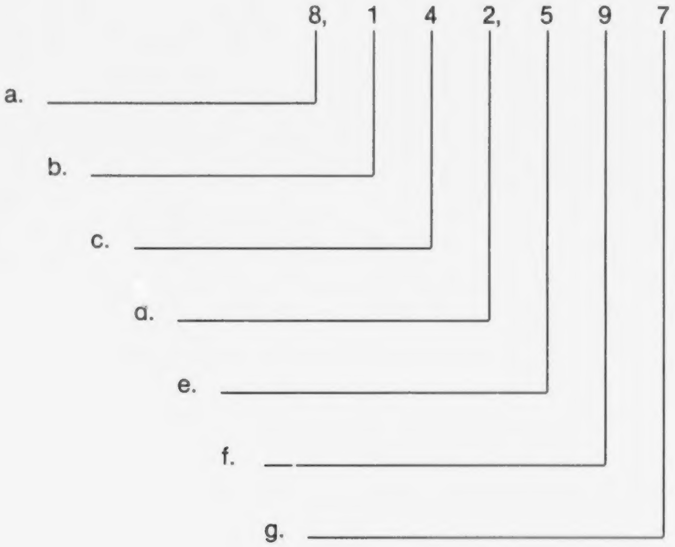
1. Digit
2. Multiplication
3. Problem
4. Nominal size
5. Subtraction
6. Whole number (integer)
7. Addition
8. Modular
9. Calculate
10. Fraction
11. Ratio
12. Proportional
13. Division
14. Decimal
15. Percent

TEST

2. Match to their correct names symbols used in math problems. Write the correct numbers in the blanks.

______a.	Plus sign (addition)	1.	=
______b.	Pi sign	2.	×
______c.	Equal sign	3.	−
______d.	Division frame	4.	÷
______e.	Ratio symbol	5.	+
______f.	Minus sign (subtraction)	6.	.
______g.	Percent symbol	7.	π
______h.	Times sign (multiplication)	8.	%
______i.	Decimal point	9.	:
______j.	Division sign	10.	⟌

3. Label the place values in the whole number below.



TEST

4. Add whole numbers to solve the following problems. Show your work.

a. $\begin{array}{r} 2 \\ +\ 9 \\ \hline \end{array}$ b. $\begin{array}{r} 5 \\ 7 \\ +\ 8 \\ \hline \end{array}$ c. $\begin{array}{r} 12 \\ 17 \\ +\ 99 \\ \hline \end{array}$ d. $\begin{array}{r} 142 \\ 759 \\ +\ 896 \\ \hline \end{array}$ e. $\begin{array}{r} 2345 \\ 9764 \\ +\ 8976 \\ \hline \end{array}$

5. Subtract whole numbers to solve the following problems. Check your answers and show your work.

a. $\begin{array}{r} 9 \\ -\ 7 \\ \hline \end{array}$ b. $\begin{array}{r} 35 \\ -\ 9 \\ \hline \end{array}$ c. $\begin{array}{r} 481 \\ -\ 79 \\ \hline \end{array}$ d. $\begin{array}{r} 684 \\ -\ 342 \\ \hline \end{array}$ e. $\begin{array}{r} 9867 \\ -\ 8748 \\ \hline \end{array}$

6. Multiply whole numbers to solve the following problems. Show your work.

a. $\begin{array}{r} 7 \\ \times\ 5 \\ \hline \end{array}$ b. $\begin{array}{r} 68 \\ \times\ 9 \\ \hline \end{array}$ c. $\begin{array}{r} 735 \\ \times\ 68 \\ \hline \end{array}$ d. $\begin{array}{r} 649 \\ \times\ 537 \\ \hline \end{array}$ e. $\begin{array}{r} 8673 \\ \times\ 642 \\ \hline \end{array}$

7. Divide whole numbers to solve the following problems. Show your work.

a. $4\overline{)48}$ b. $16\overline{)64}$ c. $38\overline{)608}$

TEST

d. $421\,\overline{)842}$ e. $317\,\overline{)4569}$ f. $530\,\overline{)80960}$

8. Distinguish among types of fractions. Write a "P" in the blanks before proper fractions, an "I" before improper fractions, and an "M" in the blanks before mixed numbers.

______a. $^{1}/_{2}$

______b. $8^{3}/_{4}$

______c. $^{8}/_{8}$

______d. $15^{3}/_{8}$

______e. $5^{3}/_{16}$

______f. $^{10}/_{32}$

______g. $^{2}/_{8}$

______h. $6^{1}/_{2}$

______i. $^{1}/_{4}$

______j. $^{99}/_{1}$

9. Reduce the following fractions to lowest terms. Write your answers in the blanks.

____________a. $^{4}/_{8}$

____________b. $^{8}/_{16}$

____________c. $^{7}/_{16}$

____________d. $^{8}/_{32}$

____________e. $^{12}/_{32}$

____________f. $^{4}/_{16}$

____________g. $^{2}/_{16}$

____________h. $^{8}/_{64}$

____________i. $^{12}/_{16}$

____________j. $^{31}/_{32}$

10. Convert the following mixed numbers to improper fractions. Reduce to lowest terms if possible. Write your answers in the blanks.

____________a. $3\frac{1}{2}$

____________b. $4\frac{2}{4}$

____________c. $3\frac{6}{8}$

____________d. $12\frac{4}{8}$

____________e. $13\frac{13}{32}$

TEST

11. Convert the following improper fractions to mixed numbers. Reduce answers to lowest terms. Write your answers in the blanks.

____________a. $\frac{47}{8}$

____________b. $\frac{21}{9}$

____________c. $\frac{108}{23}$

____________d. $\frac{54}{5}$

____________e. $\frac{112}{7}$

12. Add fractions to solve the following problems. Convert to mixed numbers if necessary, and reduce to lowest terms. Write your answers in the blanks.

____________a. $\frac{1}{8} + \frac{5}{8}$

____________b. $\frac{1}{16} + \frac{15}{16}$

____________c. $\frac{2}{4} + \frac{3}{4}$

____________d. $\frac{1}{2} + \frac{4}{8}$

____________e. $\frac{4}{8} + \frac{2}{4}$

____________f. $\frac{7}{8} + \frac{6}{16}$

____________g. $2\frac{1}{8} + 7\frac{1}{4}$

____________h. $3\frac{2}{4} + 16\frac{1}{8}$

____________i. $4\frac{2}{4} + 8\frac{2}{8}$

____________j. $5\frac{1}{8} + 6\frac{2}{16}$

13. Subtract fractions to solve the following problems. Reduce answers to lowest terms. Write your answers in the blanks.

____________a. $\frac{4}{8} - \frac{3}{8}$

____________b. $\frac{6}{8} - \frac{2}{8}$

____________c. $\frac{9}{16} - \frac{4}{16}$

____________d. $\frac{3}{8} - \frac{1}{4}$

____________e. $\frac{3}{8} - \frac{1}{8}$

____________f. $\frac{14}{16} - \frac{7}{8}$

____________g. $2\frac{3}{4} - 1\frac{1}{4}$

____________h. $6\frac{1}{8} - 2\frac{1}{2}$

____________i. $9\frac{2}{4} - 4\frac{1}{2}$

____________j. $12\frac{6}{8} - 7\frac{1}{8}$

TEST

14. Multiply fractions to solve the following problems. Reduce to lowest terms. Write your answers in the blanks.

__________a. $\frac{1}{2} \times \frac{3}{4}$

__________b. $\frac{3}{4} \times \frac{3}{8}$

__________c. $\frac{3}{2} \times \frac{1}{16}$

__________d. $\frac{3}{4} \times 6\frac{1}{2}$

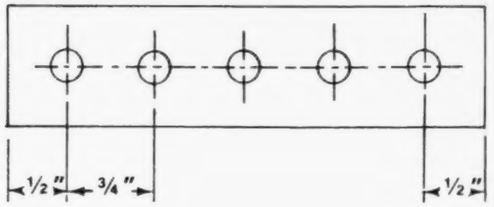
__________e. $6\frac{3}{4} \times 8\frac{3}{4}$

__________f. $7\frac{1}{8} \times 1\frac{1}{2}$

__________g. $\frac{77}{16} \times 5$

__________h. A piece of expansion material is 15 feet long. Someone cut off $\frac{1}{20}$ of its total length. How long is the cut piece? (Convert your answer to inches.)

__________i. The bolt template illustrated below is to be drilled with 5 holes equally spaced. Find the length of the template.



__________j. Two trucks are used to haul crushed rock. The larger truck hauls $3\frac{1}{2}$ cubic yards per load, and the other hauls $2\frac{1}{4}$ cubic yards per load. If each truck hauls 16 loads, what is the total quantity in cubic yards of crushed rock hauled?

TEST

15. Divide fractions to solve the following problems. Reduce to lowest terms. Write your answers in the blanks. Show your work.

a. $\frac{3}{8} \div \frac{3}{4} =$ ______________________________

b. $2\frac{1}{2} \div \frac{2}{3} =$ ______________________________

c. $\frac{3}{4} \div 5 =$ ______________________________

d. $4\frac{1}{3} \div \frac{3}{8} =$ ______________________________

e. $5\frac{3}{8} \div 3\frac{1}{4} =$ ______________________________

f. $6\frac{2}{3} \div 2 =$ ______________________________

g. $1\frac{7}{9} \div 5\frac{1}{4} =$ ______________________________

h. A truck is loaded with stones, and each stone weighs approximately 1/20 of a ton. If the total weight of the stones is 1 3/4 tons, how many stones are on the truck?

________________ stones

TEST

i. How many 9-inch-square blocks will be needed to make a sidewalk that is 3 feet wide and 15 feet long?

______________________ blocks

j. If $^{1}/_{9}$ cubic yard of cement is needed to mix 1 cubic yard of concrete, how many cubic yards can be mixed using $^{7}/_{8}$ cubic yards of cement?

______________________ cubic yards

16. Label the place values in the decimal number below.

0. 9 6 1 2 8 5

f. ________________________________

e. ________________________________

d. ________________________________

c. ________________________________

b. ________________________________

a. ________________________________

17. Add decimal numbers to solve the following problems. Set up each problem and show your work. Write your answers in the blanks.

__________ a. 3.5 + 5.1 + 7

__________ b. 3.4 + 0.206 + 1.74

__________ c. $6.86 + $5.05 + $7.90 + $.82

TEST

___________d. 57.78 + 0.22 + 0.003 + 74

___________e. 6319 + 95.12 + 0.0713 + 321.07

18. Subtract decimal numbers to solve the following problems. Set up each problem and check your work. Write your answers in the blanks.

___________a. $6.10 − $2.20

___________b. $5.40 − $2.32

___________c. $7.38 − $.63

___________d. 0.835325 − 0.25

___________e. 0.609375 − 0.359375

TEST

19. Multiply decimal numbers to solve the following problems. Set up each problem and show your work. Write your answers in the blanks.

___________a. 2.6 × 4.7

___________b. 0.119 × 0.05

___________c. 9 × 0.08

___________d. 7.392 × 92.07

___________e. 9.5 × 0.76

20. Divide decimals to solve the following problems. Set up each problem and check your work. Write your answers in the blanks.

___________a. 5.32 ÷ 0.4

___________b. 83.4 ÷ 0.6

TEST

__________c. 7.75 ÷ 0.25

__________d. 0.921 ÷ 0.3

__________e. 0.0225 ÷ 0.15

__________f. 24 ÷ 0.2

__________g. 54 ÷ 0.09

__________h. 63 ÷ 0.007

__________i. 812 ÷ 0.058

TEST

__________j. 4215 ÷ 0.040

21. Convert the following fractions to decimal numbers and percentages. Give percentages in the nearest whole percent. Write your answers in the blanks.

Decimal Number	**Percentage**	
__________	__________	a. $^{1}/_{3}$
__________	__________	b. $^{3}/_{25}$
__________	__________	c. $23^{3}/_{100}$
__________	__________	d. $11^{24}/_{1000000}$
__________	__________	e. $^{7}/_{16}$
__________	__________	f. $^{2}/_{7}$
__________	__________	g. $8^{13}/_{100000}$
__________	__________	h. $^{5}/_{6}$
__________	__________	i. $18^{3}/_{10}$
__________	__________	j. $5^{5}/_{1000}$

TEST

22. Identify decimal and fractional equivalents. Write the correct answers in the blanks.

$\frac{1}{64}$	.015625	$\frac{33}{64}$	.515625
$\frac{1}{32}$	.03125	$\frac{17}{32}$	.53125
$\frac{3}{64}$	.046875	$\frac{35}{64}$	.546875
$\frac{1}{16}$	.0625	$\frac{9}{16}$	.5625
$\frac{5}{64}$	.078125	$\frac{37}{64}$	.578125
$\frac{3}{32}$	.09375	$\frac{19}{32}$	.59375
$\frac{7}{64}$	.109375	$\frac{39}{64}$	.609375
a. ____	**.125**	$\frac{5}{8}$	e. ____
$\frac{9}{64}$	.140625	$\frac{41}{64}$	.640625
$\frac{5}{32}$	.15625	$\frac{21}{32}$	.65625
$\frac{11}{64}$	.171875	$\frac{43}{64}$	.671875
$\frac{3}{16}$	.1875	$\frac{11}{16}$	.6875
$\frac{13}{64}$	.203125	$\frac{45}{64}$	.703125
$\frac{7}{32}$	.21875	$\frac{23}{32}$	.71875
$\frac{15}{64}$	.234375	$\frac{47}{64}$	.734375
$\frac{1}{4}$	b. ____	f. ____	**.75**
$\frac{17}{64}$	.265625	$\frac{49}{64}$	.765625
$\frac{9}{32}$	.28125	$\frac{25}{32}$	.78125
$\frac{19}{64}$	.296875	$\frac{51}{64}$	.796875
$\frac{5}{16}$	.3125	$\frac{13}{16}$	.8125
$\frac{21}{64}$	.328125	$\frac{53}{64}$	.828125
$\frac{11}{32}$	.34375	$\frac{27}{32}$	.84375
$\frac{23}{64}$	.359375	$\frac{55}{64}$	.859375
c. ____	**.375**	$\frac{7}{8}$	g. ____
$\frac{25}{64}$	.390625	$\frac{57}{64}$	.890625
$\frac{13}{32}$	.40625	$\frac{29}{32}$	.90625
$\frac{27}{64}$	.421875	$\frac{59}{64}$	.921875
$\frac{7}{16}$	.4375	$\frac{15}{16}$	.9375
$\frac{29}{64}$	.453125	$\frac{61}{64}$	.953125
$\frac{15}{32}$	.46875	$\frac{31}{32}$	.96875
$\frac{31}{64}$	.484375	$\frac{63}{64}$	.984375
$\frac{1}{2}$	d. ____	1	h. ____

TEST

23. Convert the following percentages to fractions and decimal numbers. Write your answers in the blanks.

Decimal Number	Fraction	
____________	____________	a. 12%
____________	____________	b. 30%
____________	____________	c. 45%
____________	____________	d. 72%
____________	____________	e. 250%

24. Solve the following percentage problems. Write your answers in the blanks.

__________a. If a contractor paid a concrete mason $150.00, which is 87 percent of his salary, how much more money would the concrete mason have coming?

__________b. If 12 percent of the bricks for a job are stolen, how many bricks will be left of the 2100 stored for the job?

__________c. If a contractor bought a forklift for $24,000, and sold it for $30,000, what was her percentage of profit?

TEST

25. Match terms used in geometry to their correct definitions. Write the correct numbers in the blanks.

_____a. Volume of an object that is 1 foot long, 1 foot wide, and 1 foot high

_____b. Shape formed by straight or curved lines

_____c. Line or surface at a right angle to another line or surface

_____d. Outer limits or boundary

_____e. Greek letter (π) representing the ratio of a circle's circumference to its diameter; ratio approximately 3.1416

_____f. Distance around outer edge of a circle

_____g. Distance between outer edges of circle through center point

_____h. Measure of a flat surface; expressed in square units

_____i. Line from center of a circle to any point on edge of circle

_____j. Relating to, consisting of, or resembling a straight line

_____k. Extending in the same direction; equal distance apart and never meeting

_____l. Space occupied by a body; expressed in cubic units

_____m. Angle formed by two lines perpendicular to each other; 90-degree angle

_____n. Unit with three equal dimensions, including length, width, and height

1. Perimeter
2. Radius
3. Volume
4. Lineal
5. Parallel
6. Diameter
7. Geometric figure
8. Area
9. Cubic foot
10. Circumference
11. Cubic unit
12. Right angle
13. Pi
14. Perpendicular

TEST

26. Match types of geometric figures to their correct descriptions. Write the correct numbers in the blanks.

_____a. Figure having three sides and three angles

_____b. Figure having four sides of equal length and four right angles

_____c. Flat, round figure formed by one curved line; all points of curved line are equidistant from center point

_____d. Figure having no right angles and four sides of equal length

_____e. Figure with only one pair of parallel opposite sides

_____f. Figure with two parallel ends of equal length, two parallel sides of equal length, and four right angles

_____g. Figure such as a square, rectangle, or rhombus with two parallel ends of equal length and two parallel sides of equal length

1. Circle
2. Parallelogram
3. Trapezoid
4. Triangle
5. Rectangle
6. Rhombus
7. Square

27. Match units of measure to their correct equivalents. Write the correct numbers in the blanks.

_____a. Equal to five thousand, two hundred and eighty feet (5280′)

_____b. Equal to one-twelfth of a foot ($^{1}/_{12}$′) or one thirty-sixth of a yard ($^{1}/_{36}$ yard)

_____c. Equal to three feet (3′) or thirty-six inches (36″)

_____d. Equal to $^{1}/_{360}$ of a circle

_____e. Equal to sixteen and one-half feet ($16^{1}/_{2}$′)

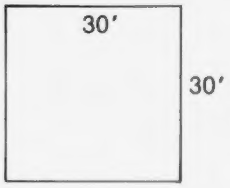
_____f. Equal to twelve inches (12″) or one-third of a yard ($^{1}/_{3}$ yard)

1. Inch (″)
2. Foot (′)
3. Yard
4. Rod
5. Mile
6. Degree (°)

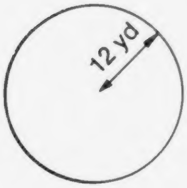
TEST

28. Calculate the area of each of the following geometric figures. Show your work. Write the correct answers in the blanks.

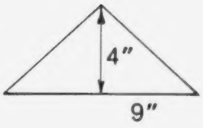
__________a.



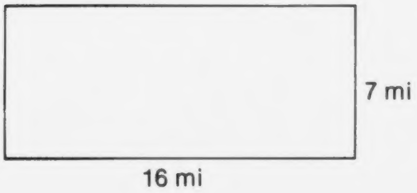
__________b.



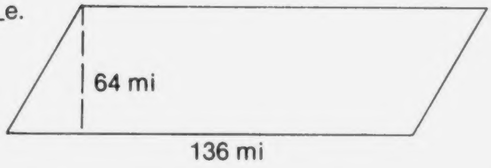
__________c.



__________d.

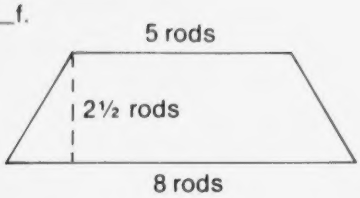


__________e.



TEST

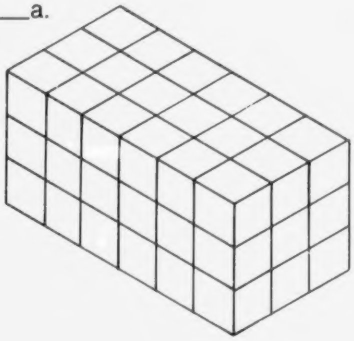
__________f.


5 rods
2½ rods
8 rods

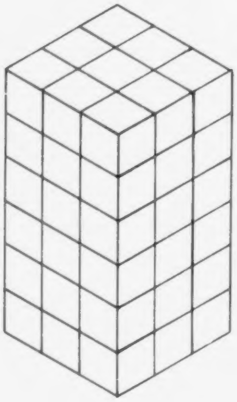
29. Calculate volume of the following solid figures. Write the correct answers in the blanks.

Counting

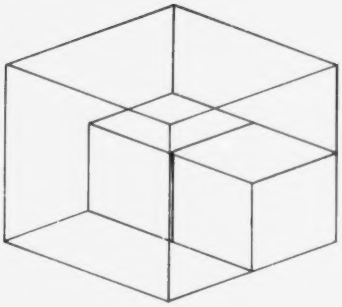
__________a.



__________b.

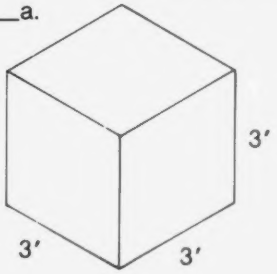


__________c.

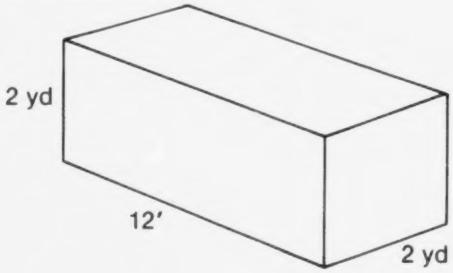


Using formula and converting as necessary

__________a.

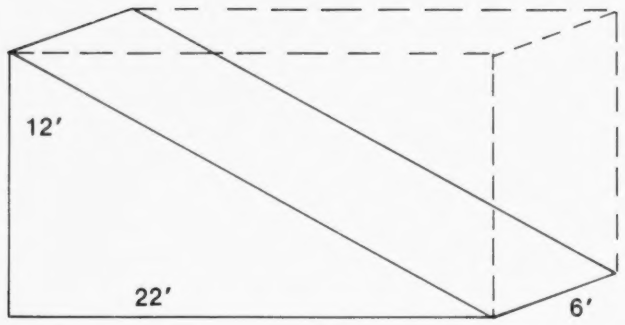


__________b.



TEST

__________c.



__________d. How many cubic yards of concrete will it take to fill a form 43 feet long, 36 feet wide, and 6 inches high?

__________e. How many cubic yards of sand will it take to fill the bed of a truck 3 feet deep, 8½ feet wide, and 12 feet long?

__________f. What would be the volume in cubic yards of a form 12 inches high, 72 inches long, and 36 inches wide?

__________g. How many cubic yards of concrete are needed to fill an area 12 feet wide, 144 feet long, and 12 inches deep?

TEST

30. Solve the following basic ratio and proportion problems. Write your answers in the blanks.

___________a. Convert the ratio 0.5:0.5:2 to the smallest whole-number proportion.

___________b. Convert the ratio 1:1:3 to a decimal proportion.

___________c. What would be the proportion if a mix of 2.5:2.5:5 were doubled?

___________d. What would be the proportion if a 3:3:12 mix were cut to one-third?

___________e. If a mixture of 2 parts cement, 4 parts lime, and 6 parts sand were needed to do a job, what would the proportion be?

f. Referring to problem "e", how many cubic feet of each proportion would it take to make 36 cubic feet of mortar?

Cubic feet cement ___________

Cubic feet lime ___________

Cubic feet sand ___________

BASIC MATH
UNIT I

ANSWERS TO TEST

1. a. 9
   b. 7
   c. 14
   d. 1
   e. 13
   f. 10
   g. 6
   h. 8
   i. 2
   j. 4
   k. 15
   l. 3
   m. 12
   n. 11
   o. 5

2. a. 5
   b. 7
   c. 1
   d. 10
   e. 9
   f. 3
   g. 8
   h. 2
   i. 6
   j. 4

3. a. Millions
   b. Hundred thousands
   c. Ten thousands
   d. Thousands
   e. Hundreds
   f. Tens
   g. Units

4. a. 11
   b. 20
   c. 128
   d. 1797
   e. 21,085

5. a. 2
   b. 26
   c. 402
   d. 342
   e. 1119

6. a. 35
   b. 612
   c. 49,980
   d. 348,513
   e. 5,568,066

7. a. 12
   b. 4
   c. 16
   d. 2
   e. 14, R 131
   f. 152, R 400

8. a. P
   b. M
   c. I
   d. M
   e. M
   f. P
   g. P
   h. M
   i. P
   j. I

9. a. $\frac{1}{2}$
   b. $\frac{1}{2}$
   c. $\frac{7}{16}$
   d. $\frac{1}{4}$
   e. $\frac{3}{8}$
   f. $\frac{1}{4}$
   g. $\frac{1}{8}$
   h. $\frac{1}{8}$
   i. $\frac{3}{4}$
   j. $\frac{31}{32}$

10. a. $\frac{7}{2}$
    b. $\frac{9}{2}$
    c. $\frac{15}{4}$
    d. $\frac{25}{2}$
    e. $\frac{429}{32}$

11. a. $5\frac{7}{8}$
    b. $2\frac{1}{3}$
    c. $4\frac{16}{23}$
    d. $10\frac{4}{5}$
    e. 16

12. a. $\frac{3}{4}$
    b. 1
    c. $1\frac{1}{4}$
    d. 1
    e. 1
    f. $1\frac{1}{4}$
    g. $9\frac{3}{8}$
    h. $19\frac{5}{8}$
    i. $12\frac{3}{4}$
    j. $11\frac{1}{4}$

13. a. $\frac{1}{8}$
    b. $\frac{1}{2}$
    c. $\frac{5}{16}$
    d. $\frac{1}{8}$
    e. $\frac{1}{4}$
    f. 0
    g. $1\frac{1}{2}$
    h. $3\frac{5}{8}$
    i. 5
    j. $5\frac{5}{8}$

ANSWERS TO TEST

14. a. 3/8
b. 9/32
c. 3/32
d. 4 7/8
e. 59 1/16
f. 10 11/16
g. 24 1/16
h. 9 inches
i. 4 inches
j. 92 cubic yards

15. a. 1/2
b. 3 3/4
c. 3/20
d. 11 5/9
e. 1 17/26
f. 3 1/3
g. 64/189
h. 35
i. 80
j. 7 7/8

16. a. Tenths
b. Hundredths
c. Thousandths
d. Ten thousandths
e. Hundred thousandths
f. Millionths

17. a. 15.6
b. 5.346
c. $20.63
d. 132.003
e. 6735.2613

18. a. $3.90
b. $3.08
c. $6.75
d. 0.585325
e. 0.25

19. a. 12.22
b. 0.00595
c. 0.72
d. 680.58144
e. 7.22

20. a. 13.3
b. 139
c. 31
d. 3.07
e. 0.15
f. 120
g. 600
h. 9000
i. 14,000
j. 105,375

21. a. 0.3333; 33%
b. 0.12; 12%
c. 23.03; 2303%
d. 11.000024; 1100%
e. 0.4375; 44%
f. 0.2857;29%
g. 8.00013; 800%
h. 0.8333; 83%
i. 18.3; 1830%
j. 5.005;501%

22. a. 1/8
b. .25
c. 3/8
d. .5
e. .625
f. 3/4
g. .875
h. 1

23. a. 0.12; 3/25
b. 0.30; 3/10
c. 0.45; 9/20
d. 0.72; 18/25
e. 2.50; 2 1/2

24. a. $22.41
b. 1848 bricks
c. 20 percent

25. a. 9
b. 7
c. 14
d. 1
e. 13
f. 10
g. 6
h. 8
i. 2
j. 4
k. 5
l. 3
m. 12
n. 11

26. a. 4
b. 7
c. 1
d. 6
e. 3
f. 5
g. 2

27. a. 5
b. 1
c. 3
d. 6
e. 4
f. 2

28. a. 900 square feet
b. 452.16 square yards
c. 18 square inches
d. 112 square miles
e. 8704 square miles
f. 16 1/4 square rods

ANSWERS TO TEST

29. **Counting**

    a. 54 cubic units
    b. 54 cubic units
    c. 8 cubic units

    Using formula and converting as necessary

    a. 1 cubic yard
    b. 16 cubic yards
    c. 29 $^{1}/_{3}$ cubic yards
    d. 28.66 or 28 $^{2}/_{3}$ cubic yards
    e. 11.33 or 11 $^{1}/_{3}$ cubic yards
    f. .66 or $^{2}/_{3}$ cubic yards
    g. 64 cubic yards

30. a. 1:1:4
    b. 0.33:0.33:1 or any other proportional decimal
    c. 5:5:10
    d. 1:1:4
    e. 2:4:6
    f. 6 cubic feet of cement, 12 cubic feet of lime, 18 cubic feet of sand

MEASURING
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to read rules and accurately measure objects. The student will show this ability by completing an assignment sheet, job sheet, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with measuring.
2. Identify basic measuring tools used by concrete masons.
3. List common errors that contribute to incorrect measurements.
4. Identify graduations on a folding rule.
5. Read a folding rule to the nearest fraction of an inch.
6. Convert fractional inches to hundredths of a foot.
7. Identify graduations on an engineer's rule.
8. Read an engineer's rule to the nearest hundredth of a foot.
9. Identify graduations on a tape.
10. Read a tape to the nearest fraction of an inch.
11. Describe measuring methods used to square lines.
12. Measure objects.
13. Demonstrate the ability to use basic measuring tools and the 3-4-5 method to lay out the perimeter of a building on a concrete slab.

MEASURING
UNIT II

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

    1. Supplement #1 — Measuring Terms Word Search

    2. Transparency masters

      a. TM #1 — Graduations on a Folding Rule

      b. TM #2 — Graduations on a Folding Rule (Continued)

      c. TM #3 — Graduations on an Engineer's Rule

      d. TM #4 — Reading Fourths on a Folding Rule

      e. TM #5 — Reading Eighths on a Folding Rule

      f. TM #6 — Reading Sixteenths on a Folding Rule

  C. Information sheet

  D. Assignment sheets

    1. Assignment Sheet #1 — Read Measurements on Rules

    2. Assignment Sheet #2 — Measure Objects

    3. Assignment Sheet #3 — Convert Fractional Inches to Hundredths of a Foot

    4. Assignment Sheet #4 — Read Measurements on Tapes

  E. Answers to assignments sheets

  F. Job Sheet #1 — Use Basic Measuring Tools and the 3-4-5 Method to Lay Out the Perimeter of a Building on a Concrete Slab

  G. Test

  H. Answers to test

SUGGESTED ACTIVITIES

II. Instructor's guide

- A. Review unit and plan presentation.
- B. Obtain materials to supplement unit.
  1. Folding rules, engineer's rules, and tapes for each class member
  2. Several pieces of lumber or metal of different lengths
  3. Equipment and materials needed to perform procedures outlined in assignment and job sheets
  4. Transparencies and competency profiles

     (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or The Associated General Contractors of America, 1957 E Street N.W., Washington, D.C. 20006. Phone: 202-393-2040.)
- C. Make transparencies and additional copies of the supplement as desired.
- D. Introduce unit to students.
- E. Provide students with objective sheet.
- F. Discuss unit and specific objectives, emphasizing how important measuring is to the concrete masonry trade and pointing out the importance of knowing how to read and use rules, tapes, and squares accurately.
- G. Provide students with information, assignment, and job sheets.
- H. Discuss information, assignment, and job sheets.
  1. Use Information Sheet, Section I, to discuss terms associated with measuring.

     SUGGESTIONS:

     - Use the chalkboard and actual items to supplement your explanation of each term.
     - Have students review terms by completing Supplement #1, "Measuring Terms Word Search."
  2. Use Information Sheet, Section II, to discuss basic measuring tools used by concrete masons.

     SUGGESTIONS:

     - Obtain actual measuring tools and have students identify them.

SUGGESTED ACTIVITIES

- Make flash cards containing pictures of the tools. Have students play games using the flash cards.
- Discuss the importance of purchasing and using quality tools.

3. Use Information Sheet, Section III, to discuss common errors that contribute to incorrect measurements. Encourage students to double-check all measurements and math calculations.

4. Use Information Sheet, Section IV, to discuss graduations on a folding rule.

   SUGGESTIONS:

   - Provide each student with a folding rule.
   - Use Transparencies #1 and #2 to illustrate graduations on a folding rule.
   - Have students work in teams of two; have one team member point out various graduations on the folding rule for the other to identify.

5. Use Information Sheet, Section V, to discuss reading a folding rule to the nearest fraction of an inch.

   SUGGESTIONS:

   - Provide each student with a folding rule graduated in sixteenths.
   - Use Transparencies #4 through #6 to illustrate the fourths, eighths, and sixteenths markings on the rule.
   - Have students use the folding rule to measure and record the lengths of several pieces of lumber or metal.
   - Have students practice reading a folding rule to the nearest fraction of an inch by completing Part I of Assignment Sheets #1 and #2.

6. Use Information Sheet, Section VI, to discuss converting fractional inches to hundredths of a foot.

   SUGGESTIONS:

   - Have students memorize the three steps in the conversion process outlined in the information sheet. Emphasize how easy this method is and how quickly fractions and inches can be converted once the method is learned.

SUGGESTED ACTIVITIES

- Have students review the section on converting fractions in Unit I, "Basic Math."
- Make flash cards with fractional inches on one side and the correct hundredths conversion on the other side. Have students team up to practice converting fractional inches to hundredths of a foot.
- Have students practice converting fractional inches to hundredths of a foot by completing Assignment Sheet #3.

7. Use Information Sheet, Section VII, to discuss graduations on an engineer's rule.

SUGGESTIONS:

- Provide each student with an engineer's rule.
- Use Transparency #3 to illustrate graduations on an engineer's rule.
- Have students work in teams of two; have one team member point out various graduations on the engineer's rule for the other to identify.

8. Use Information Sheet, Section VIII, to discuss reading an engineer's rule to the nearest hundredth of a foot.

SUGGESTIONS:

- Provide each student with an engineer's rule.
- Have students use the engineer's rule to measure and record the lengths of the pieces of lumber or metal gathered for Section V. Compare their measurements, and explain the importance of converting from inches to hundredths or from hundredths to inches.
- Have students practice reading an engineer's rule to the nearest hundredth of a foot by completing Part II of Assignment Sheets #1 and #2.
- Draw lines on poster board or on the floor. Have students practice measuring the lines.

9. Use Information Sheet, Sections IX and X, to discuss graduations on a tape and reading a tape to the nearest fraction of an inch.

SUGGESTIONS:

- Provide each student with a tape.
- Have students use procedures outlined in the information sheet to complete Assignment Sheet #4, "Read Measurments on Tapes."

SUGGESTED ACTIVITIES

- Have students practice measuring the lengths and widths of the classroom, the shop, the building, and so on.
- Provide a practice exercise in which students have to make general measurements within a specified time.
- Discuss and demonstrate procedures outlined in Job Sheet #1, using the floor plan furnished with the job sheet. Have students measure and lay out interior dimensions and partition walls if desired.
- If necessary, review Unit III, "Basic Plan Reading," before having students complete Job Sheet #1.

10. Use Information Sheet, Section XI, and Job Sheet #1 to explain and demonstrate the 3-4-5 and diagonal methods used to square lines.

I. Give test.

J. Critique test and discuss in class.

K. Reteach and retest as necessary.

L. Complete appropriate section of competency profiles.

III. Unit references

A. Hendrix, Laborn J., "Bud." *Bricklaying Curriculum, Basic Core*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1983.

B. Hendrix, Laborn J., "Bud." *Commercial Carpentry Curriculum Material*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1979.

C. Hendrix, Laborn J., "Bud." *Fundamentals of Carpentry*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1985.

D. McDonnell, Leo P. *Hand Woodworking Tools*. Albany, New York: Delmar Publishers, 1962.

E. *Stanley Tool Guide*. New Britain, Connecticut: Stanley Works, Stanley Tools Division, Educational Department, 1972.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — MEASURING TERMS WORD SEARCH

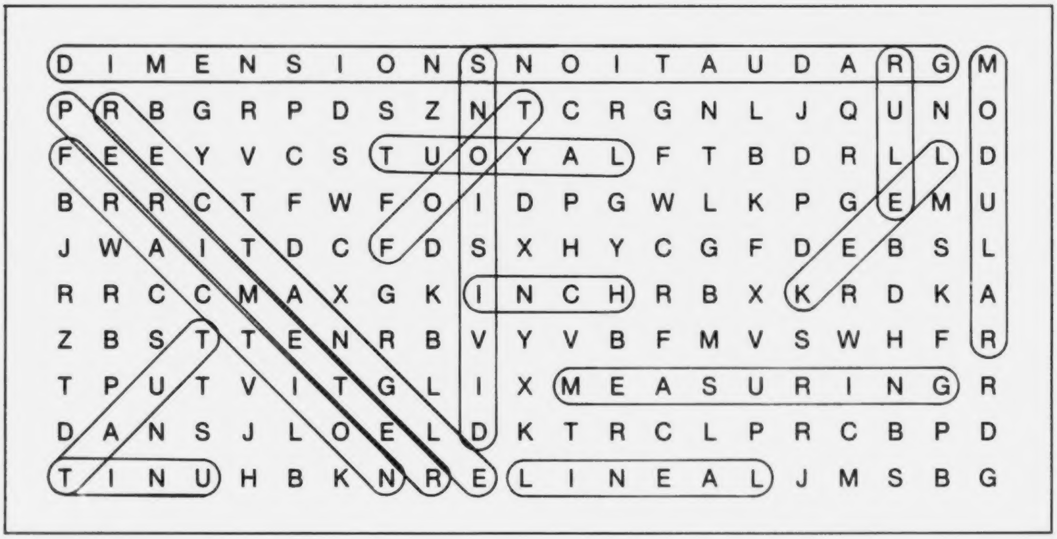
The following measuring terms are hidden in the puzzle below. Find and circle each term. Words may be spelled forward, backward, from top to bottom, or diagonally. A score of 8 is good, 10 is excellent, and 15 is super. The solution to the word search is given on the following page.

- DIMENSIONS
- DIVISIONS
- FOOT
- FRACTION
- GRADUATIONS
- INCH
- KEEL
- LAYOUT
- LINEAL
- MEASURING
- MODULAR
- PERIMETER
- RECTANGLE
- RULE
- TAUT
- UNIT

D	I	M	E	N	S	I	O	N	S	N	O	I	T	A	U	D	A	R	G	M
P	R	B	G	R	P	D	S	Z	N	T	C	R	G	N	L	J	Q	U	N	O
F	E	E	Y	V	C	S	T	U	O	Y	A	L	F	T	B	D	R	L	L	D
B	R	R	C	T	F	W	F	O	I	D	P	G	W	L	K	P	G	E	M	U
J	W	A	I	T	D	C	F	D	S	X	H	Y	C	G	F	D	E	B	S	L
R	R	C	C	M	A	X	G	K	I	N	C	H	R	B	X	K	R	D	K	A
Z	B	S	T	T	E	N	R	B	V	Y	V	B	F	M	V	S	W	H	F	R
T	P	U	T	V	I	T	G	L	I	X	M	E	A	S	U	R	I	N	G	R
D	A	N	S	J	L	O	E	L	D	K	T	R	C	L	P	R	C	B	P	D
T	I	N	U	H	B	K	N	R	E	L	I	N	E	A	L	J	M	S	B	G

SUPPLEMENT #1

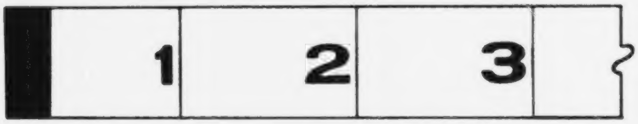
Answers to Measuring Terms Word Search



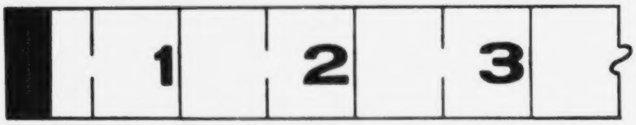
D	I	M	E	N	S	I	O	N	S	N	O	I	T	A	U	D	A	R	G	M
P	R	B	G	R	P	D	S	Z	N	T	C	R	G	N	L	J	Q	U	N	O
F	E	E	Y	V	C	S	T	U	O	Y	A	L	F	T	B	D	R	L	L	D
B	R	R	C	T	F	W	F	O	I	D	P	G	W	L	K	P	G	E	M	U
J	W	A	I	T	D	C	F	D	S	X	H	Y	C	G	F	D	E	B	S	L
R	R	C	C	M	A	X	G	K	I	N	C	H	R	B	X	K	R	D	K	A
Z	B	S	T	T	E	N	R	B	V	Y	V	B	F	M	V	S	W	H	F	R
T	P	U	T	V	I	T	G	L	I	X	M	E	A	S	U	R	I	N	G	R
D	A	N	S	J	L	O	E	L	D	K	T	R	C	L	P	R	C	B	P	D
T	I	N	U	H	B	K	N	R	E	L	I	N	E	A	L	J	M	S	B	G

Graduations on a Folding Rule

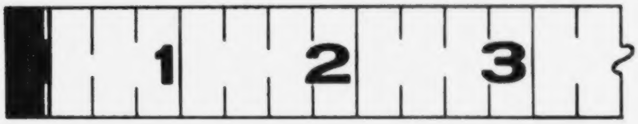
Inches



Halves



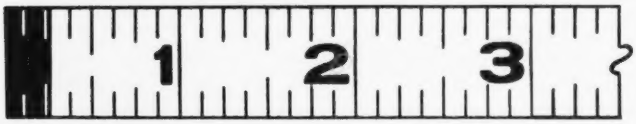
Quarters or Fourths



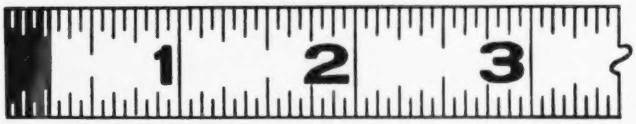
Graduations on a Folding Rule

(Continued)

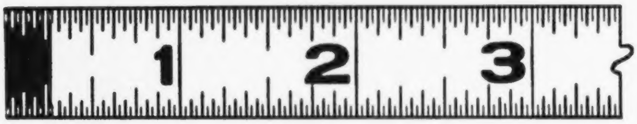
Eighths



Sixteenths

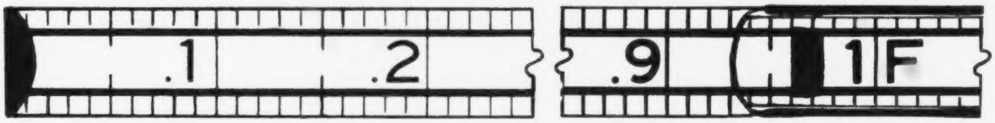


Thirty-Seconds

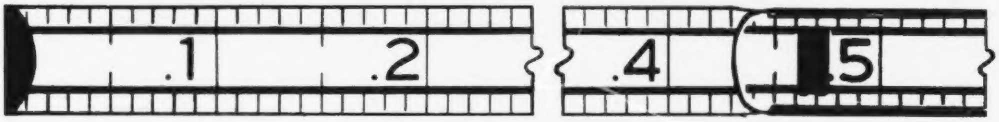


Graduations on an Engineer's Rule

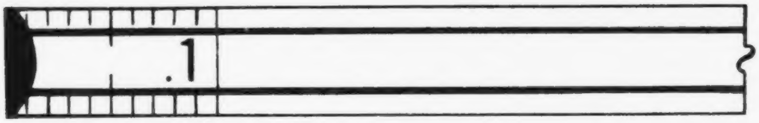
Ten 10ths equal 1 foot.



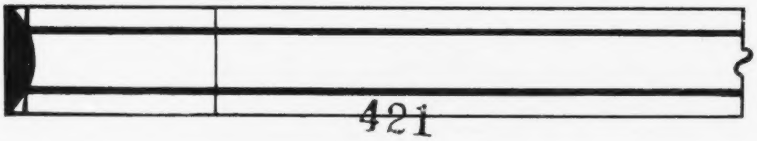
Five 10ths equal 6 inches or 1/2 foot.



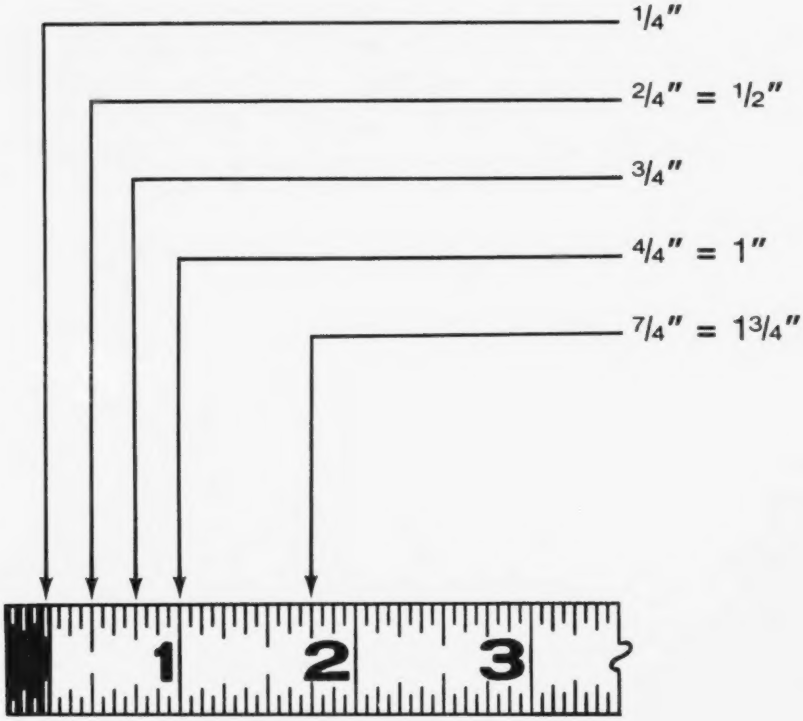
One 10th equals 1/10 of a foot or ten 100ths.



One 100th equals 1/10 of a 10th.

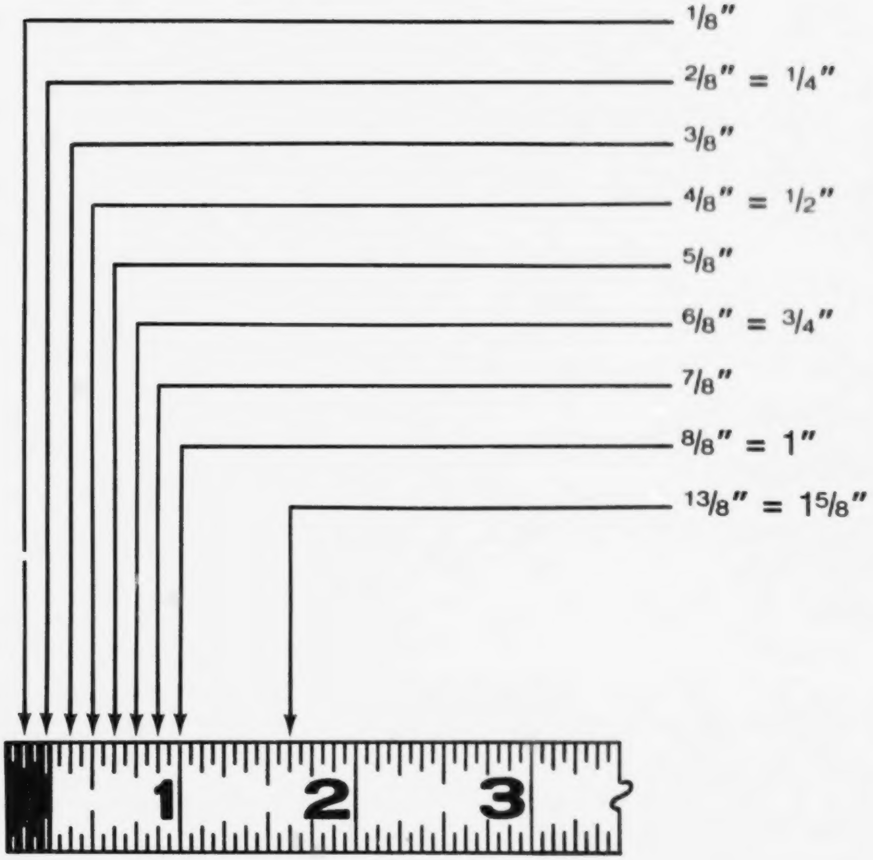


Reading Fourths on a Folding Rule

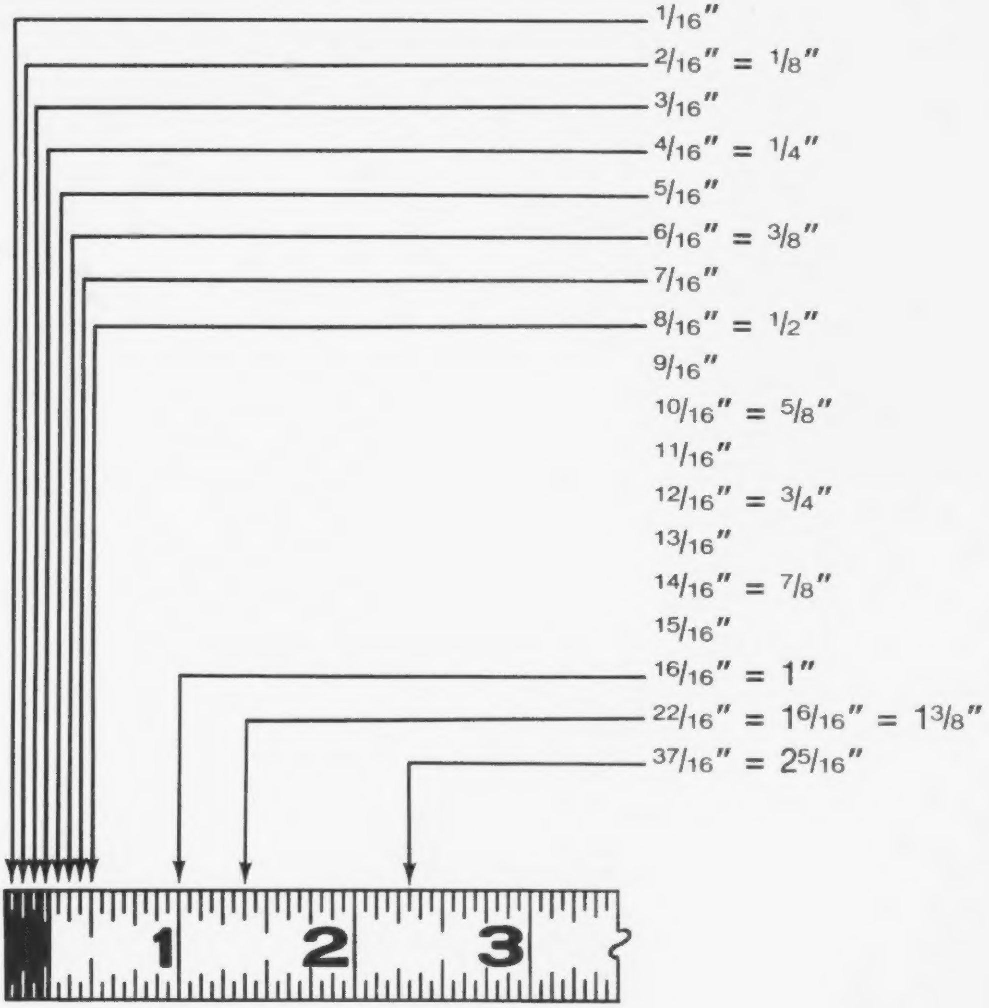

1/4"
2/4" = 1/2"
3/4"
4/4" = 1"
7/4" = 1 3/4"
1
2
3

FCCM - 181-B

Reading Eighths on a Folding Rule


1/8"
2/8" = 1/4"
3/8"
4/8" = 1/2"
5/8"
6/8" = 3/4"
7/8"
8/8" = 1"
13/8" = 15/8"
1
2
3

Reading Sixteenths on a Folding Rule


1/16"
2/16" = 1/8"
3/16"
4/16" = 1/4"
5/16"
6/16" = 3/8"
7/16"
8/16" = 1/2"
9/16"
10/16" = 5/8"
11/16"
12/16" = 3/4"
13/16"
14/16" = 7/8"
15/16"
16/16" = 1"
22/16" = 1 6/16" = 1 3/8"
37/16" = 2 5/16"
1
2
3

MEASURING
UNIT II

INFORMATION SHEET

I. Terms and definitions associated with measuring

A. Measuring — Setting of limits or bounds according to a predetermined standard

(NOTE: The standard used in measuring is called a *unit of measurement* or simply *unit*. Examples of units used to measure distance include inches, feet, meters, and miles.)

B. Rule — Measuring instrument graduated in whole units and fractions of units

(NOTE: The term *rule* is generally applied to any measuring instrument used to determine distances. One special kind of rule is the *tape*, a steel strip marked in graduations. Tapes can be reeled into a container. In concrete masonry, a rule is usually used for measuring distances of a few feet or less and for marking straight lines. A tape is used for measuring distances from a few inches to a hundred feet or more.)

C. Graduations — Marks on a rule or tape indicating measurements

EXAMPLES: Sixteenths, quarters, halves, inches, and feet; hundredths, tenths, and feet

D. Foot — Unit of measure consisting of twelve equal parts called *inches*

E. Inch — Smallest whole unit of lineal measure commonly used

F. Divisions — Parts or sections that make up 1 inch on a rule

G. Fraction — Part of a whole; represents one or more equal parts of a unit

EXAMPLES: 1/2, 3/8, 1/4, 3/16

H. Lineal — Relating to, consisting of, or resembling a straight line

I. Dimensions — Arrangement of lines to indicate the actual size for constructing the object or structure represented

J. Layout — Plan or design of the project to be constructed

K. Perimeter — Outer limits or boundaries

L. Keel — Type of colored marking crayon used in construction

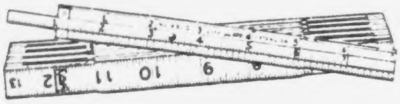
M. Taut — Tightly stretched; not slack

INFORMATION SHEET

II. Basic measuring tools used by concrete masons (Figures 1-9)

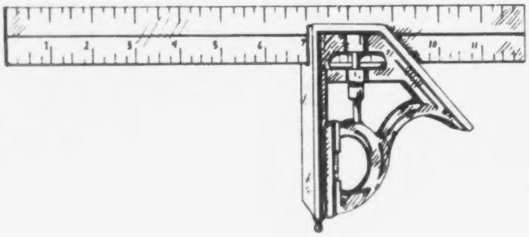
A. Folding rule

FIGURE 1



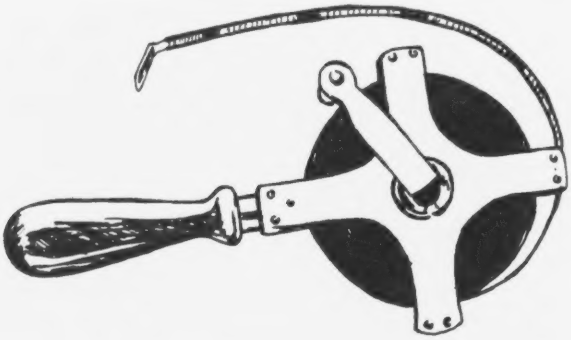
B. Combination square

FIGURE 2



C. Two-hundred-foot steel tape and reel

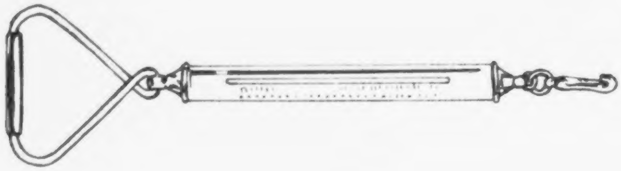
FIGURE 3



INFORMATION SHEET

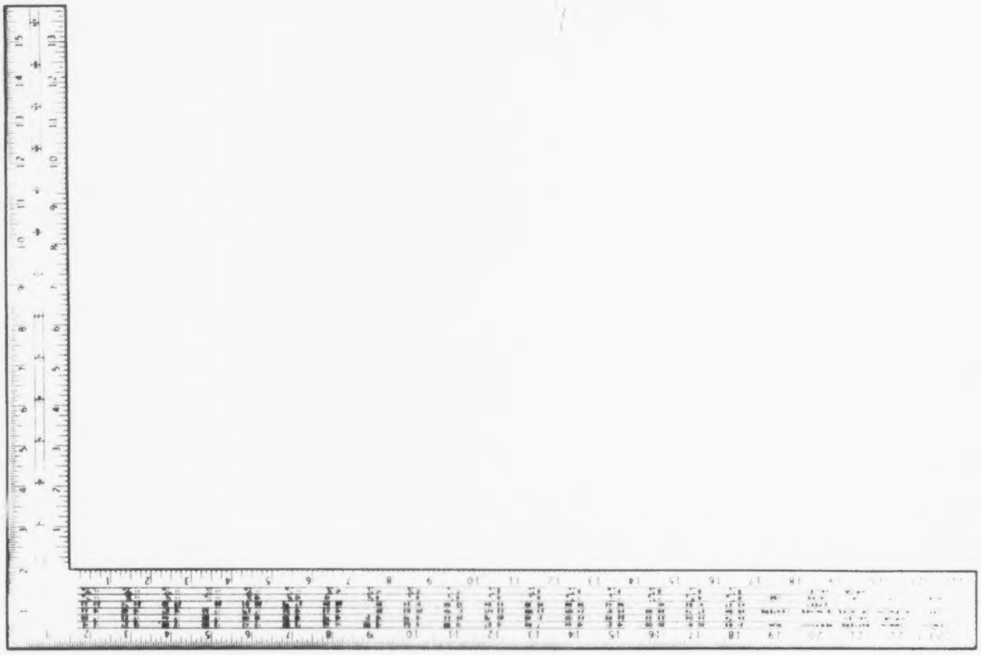
D. Spring-balanced tape-tension handle

FIGURE 4



E. Steel framing square

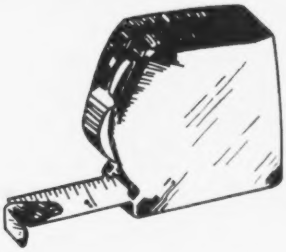
FIGURE 5



INFORMATION SHEET

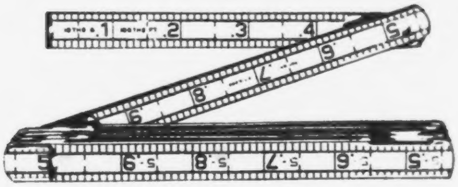
F. Steel tape

FIGURE 6



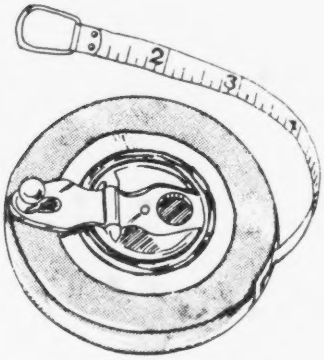
G. Engineer's folding rule

FIGURE 7



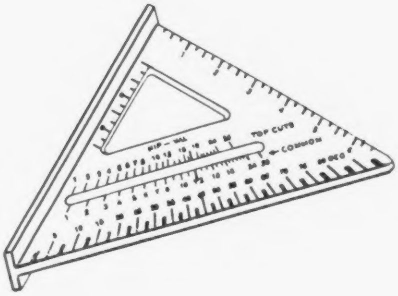
H. One-hundred-foot steel tape

FIGURE 8



I. Speed square™

FIGURE 9



Used with permission of the Swanson Tool Company, Inc., Oak Lawn, Illinois.

III. Common errors that contribute to incorrect measurements

A. Leaving slack in tape

B. Not laying tape flat (tape is twisted or kinked)

C. Not aligning tape or rule properly

D. Not placing end of tape or rule on reference point

E. Reading incorrect number

F. Recording incorrect number

G. Using wrong reference point

H. Making errors in mathematical computations

EXAMPLE: When converting from one unit of measurement to another

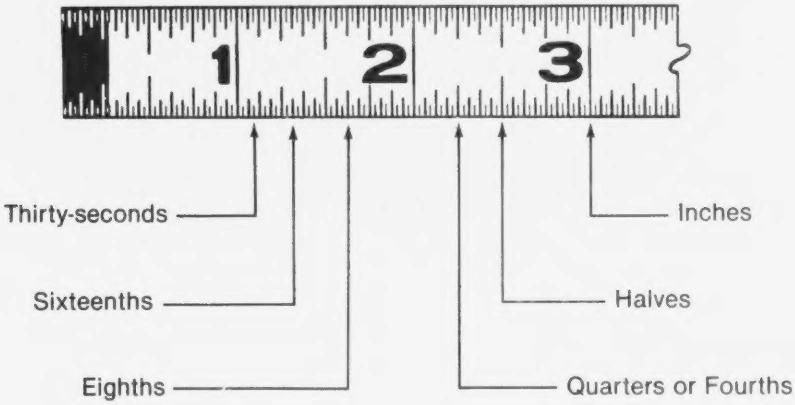
INFORMATION SHEET

I. Using incorrect measuring tool for job being performed

IV. Graduations on a folding rule (Figure 10)

(NOTE: Some rules will not have all of the graduations shown in Figure 10.)

FIGURE 10



(NOTE: Thirty-two 32nds equal 1 inch. Sixteen 16ths equal 1 inch. Eight 8ths equal 1 inch. Four 4ths equal 1 inch. Two halves equal 1 inch. Twelve inches equal 1 foot.)

V. Reading a folding rule to the nearest fraction of an inch

(NOTE: All rules are read similarly. However, rules may have different graduations, and some rules may have special markings for specific purposes. Layout rules, for instance, are marked every 16 inches as an aid in determining stud locations on 16-inch centers.)

A. Align the end of the rule with one reference point

B. Determine the number of whole units between end of rule and second reference point

(NOTE: The unit of measurement will vary, depending on the distance being measured and the use being made of the measurement. Most short measurements are made in inches, even if they are more than 1 foot long. Skilled concrete masons are generally able to quickly convert measurements from feet to inches or vice versa for distances of 10 to 12 feet or more. Thus, a concrete mason may speak of a sheet of plywood as 4 by 8 feet or as 48 by 96 inches.)

C. Determine the number of fractional units between last whole unit and second reference point

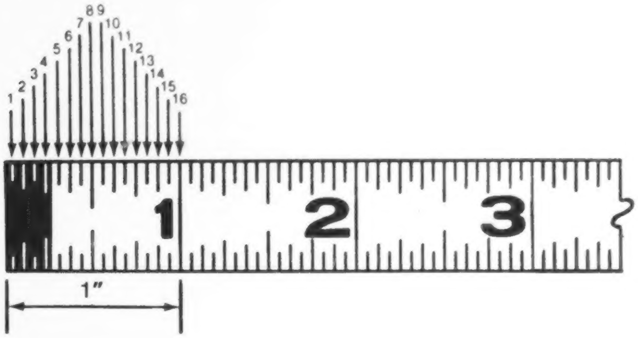
INFORMATION SHEET

1. Determine number of graduations per inch (Figure 11)

   (NOTE: At first you may have to count the number of divisions in an inch. However, with some practice, you will be able to recognize the divisions on sight and will eventually be able to determine fractional units just by looking at the rule.)

   EXAMPLE:

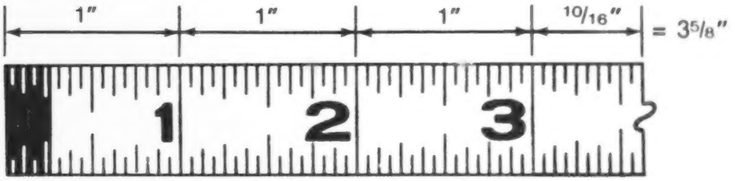
FIGURE 11



2. Determine the fractional part of an inch by counting the number of divisions between last inch and second reference point
3. Reduce the fraction if possible (Figure 12)

   EXAMPLE:

FIGURE 12



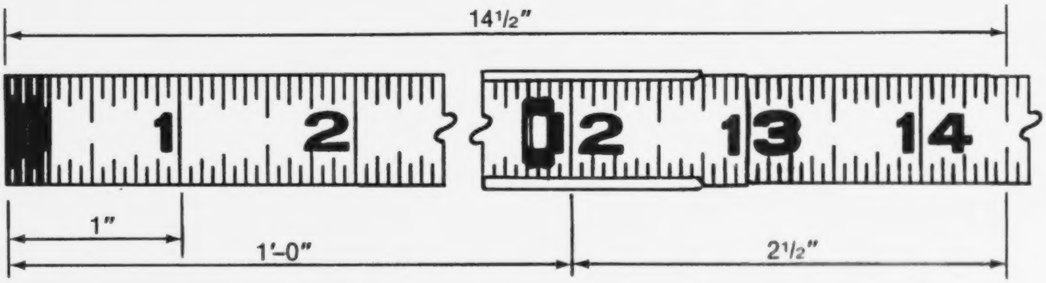
(NOTE: In the example above, the rule is divided into sixteenths. There are ten divisions between the last inch mark—3 inches—and the reference point. The $^{10}/_{16}$ can be reduced to $^{5}/_{8}$.)

INFORMATION SHEET

D. Determine the reading by adding fractional units to whole units and converting inches to feet or feet to inches if necessary (Figure 13)

EXAMPLE: The rule below shows a measurement of 1′ – 2 1/2″ or 14 1/2″.

FIGURE 13



VI. Converting fractional inches to hundredths of a foot

(NOTE: There are two general methods used by the industry today for converting fractional inches to hundredths of a foot. One method is to apply the formula and rules described in this section. The formula is not exact, but it is generally accurate enough for the requirements of the concrete masonry trade and for use with the rules that a concrete mason may have. The second method is to refer to a conversion table. See Table 1.)

A. Apply the following guidelines in the conversion process

1. Consider each 12 inches to be equal to 1.00 foot
2. Consider each 1/8 inch to be equal to 0.01 foot
3. To allow for the difference between 1/8 inch and 0.01 foot, add another 0.01 foot for 2 inches, 0.02 foot for 5 inches, 0.03 foot for 8 inches, and 0.04 foot for 11 inches

B. Use the following steps in the conversion process

1. Write the number of whole feet as a whole number to the left of the decimal point
2. Convert the remaining inches and fractional parts of inches to hundredths of a foot
    a. Change the inches and fractions to eighths, rounding sixteenths and thirty-seconds to the nearest eighth as necessary

INFORMATION SHEET

b. Multiply the numerator by 0.01

c. Add the product of the two numbers to the whole-foot number determined in Guideline A3

3. Add the required number for quantities of 2 inches or more as described in Step A3

EXAMPLE 1: Convert $14' - 5\,^{1}/_{4}''$ to hundredths of an inch.

a. $14' = 14.00'$

b. $5\,^{1}/_{4}'' = {}^{21}/_{4}'' = {}^{42}/_{8}''$

c. $42 \times 0.01 = 0.42$

d. Add 0.02 for 5 inches

e.
$$\begin{array}{r} 14.00 \\ 0.42 \\ +\ 0.02 \\ \hline 14.44' \end{array}$$

EXAMPLE 2: Convert $5' - {}^{3}/_{16}''$ to hundredths of a foot.

a. $5' = 5.00'$

b. ${}^{3}/_{16}'' = {}^{1.5}/_{8}''$

c. ${}^{1.5}/_{8}''$ rounds to ${}^{2}/_{8}''$

d. $2 \times 0.01 = 0.02$

e.
$$\begin{array}{r} 5.00 \\ +0.02 \\ \hline 5.02' \end{array}$$

INFORMATION SHEET

EXAMPLE:

TABLE 1: Standard hundredths conversion

1/8" = .01
1/4" = .02
3/8" = .03
1/2" = .04
5/8" = .05
3/4" = .06
7/8" = .07

1" = .08
1 1/8" = .09
1 1/4" = .10
1 3/8" = .11
1 1/2" = .12
1 5/8" = .13
1 3/4" = .14
1 7/8" = .15

2" = .16 + .01 = .17
2 1/8" = .18
2 1/4" = .19
2 3/8" = .20
2 1/2" = .21
2 5/8" = .22
2 3/4" = .23
2 7/8" = .24
3" = .25

3 1/8" = .26
3 1/4" = .27
3 3/8" = .28
3 1/2" = .29
3 5/8" = .30
3 3/4" = .31
3 7/8" = .32

4" = .33
4 1/8" = .34
4 1/4" = .35
4 3/8" = .36
4 1/2" = .37
4 5/8" = .38
4 3/4" = .39
4 7/8" = .40

5" = .41 + .01 = .42
5 1/8" = .43
5 1/4" = .44
5 3/8" = .45
5 1/2" = .46
5 5/8" = .47
5 3/4" = .48
5 7/8" = .49
6" = .50

6 1/8" = .51
6 1/4" = .52
6 3/8" = .53
6 1/2" = .54
6 5/8" = .55
6 3/4" = .56
6 7/8" = .57

7" = .58
7 1/8" = .59
7 1/4" = .60
7 3/8" = .61
7 1/2" = .62
7 5/8" = .63
7 3/4" = .64
7 7/8" = .65

8" = .66 + .01 = .67
8 1/8" = .68
8 1/4" = .69
8 3/8" = .70
8 1/2" = .71
8 5/8" = .72
8 3/4" = .73
8 7/8" = .74
9" = .75

9 1/8" = .76
9 1/4" = .77
9 3/8" = .78
9 1/2" = .79
9 5/8" = .80
9 3/4" = .81
9 7/8" = .82

10" = .83
10 1/8" = .84
10 1/4" = .85
10 3/8" = .86
10 1/2" = .87
10 5/8" = .88
10 3/4" = .89
10 7/8" = .90

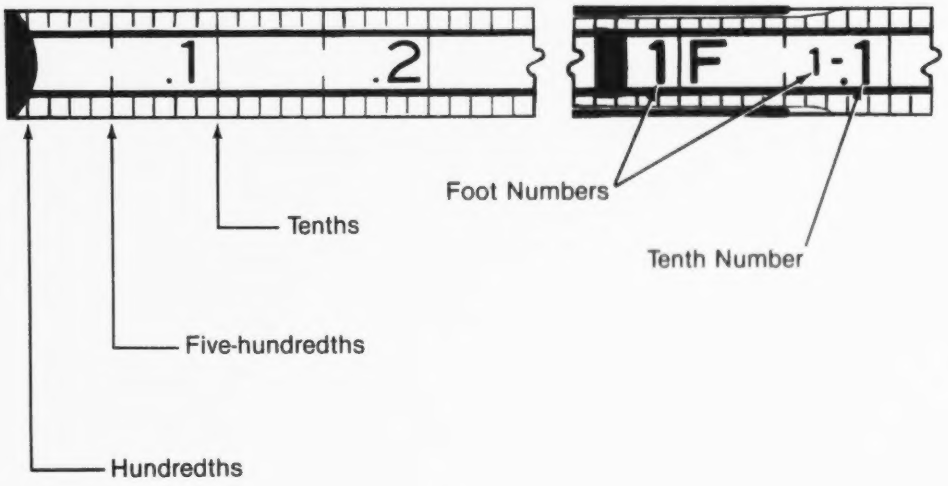
11" = .91 + .01 = .92
11 1/8" = .93
11 1/4" = .94
11 3/8" = .95
11 1/2" = .96
11 5/8" = .97
11 3/4" = .98
11 7/8" = .99
12" = 1.00

INFORMATION SHEET

VII. Graduations on an engineer's rule (Figure 14)

(NOTE: Many engineer's rules contain running-foot indicators.)

FIGURE 14



(NOTE: Ten 100ths equal $^{1}/_{10}$ of a foot. Two $^{5}/_{100\text{ths}}$ equal $^{1}/_{10}$ of a foot. Ten 10ths equal 1 foot. Notice that the other graduations on the engineer's rule are also commonly referred to. For example, twenty-five hundredths [0.25] is the same as $^{1}/_{4}$ foot or 3 inches, and fifty hundredths [0.050] is the same as $^{1}/_{2}$ foot or 6 inches.)

VIII. Reading an engineer's rule to the nearest hundredth of a foot

A. Align end of the rule with one reference point

B. Determine the number of whole units between end of rule and second reference point

(NOTE: The units may be feet or tenths of a foot, depending on the distance measured and the use to be made of the measurement.)

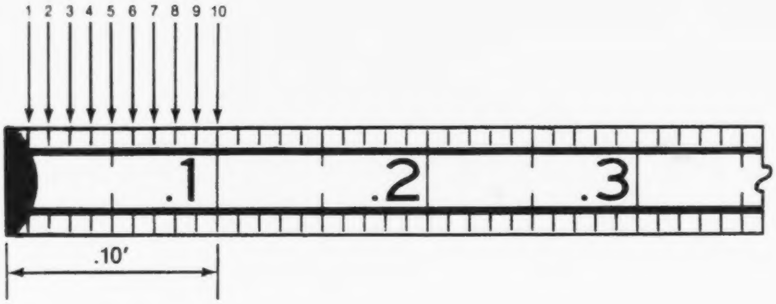
C. Determine the number of decimal units between last whole unit and second reference point

1. Determine the number of graduations per unit (See Figure 15)

INFORMATION SHEET

EXAMPLE: A rule marked off in tenths of a foot may have graduations for each tenth of a tenth or each hundredth of a foot.

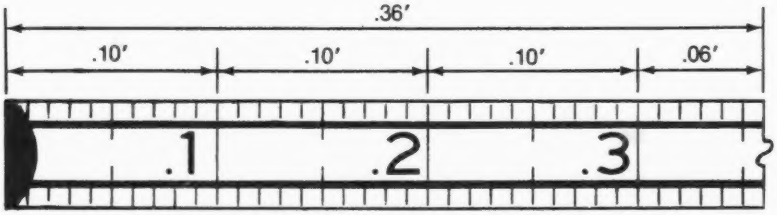
FIGURE 15



2. Count the number of hundredths between last full tenth and second reference point (Figure 16)

EXAMPLE: The rule below shows a measurement of 36 hundredths of a foot, or 0.36′.

FIGURE 16

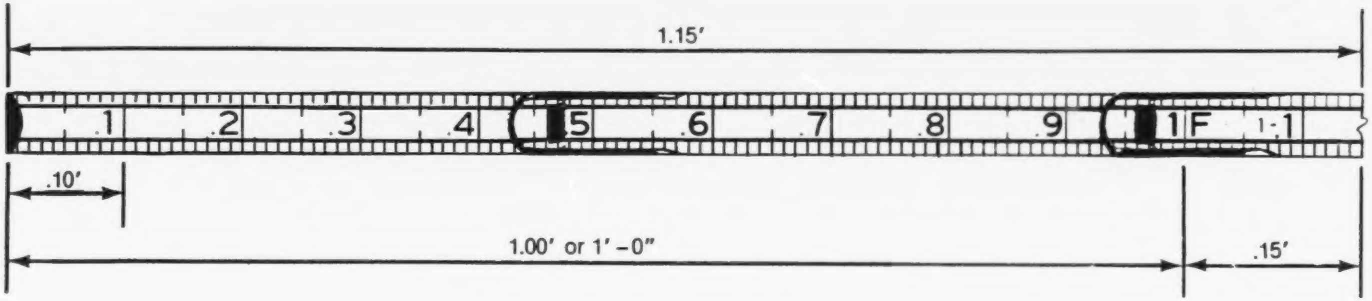


D. Determine the reading by adding decimal units to whole units and converting to feet and decimal parts of a foot if desired (See Figures 17 and 18)

INFORMATION SHEET

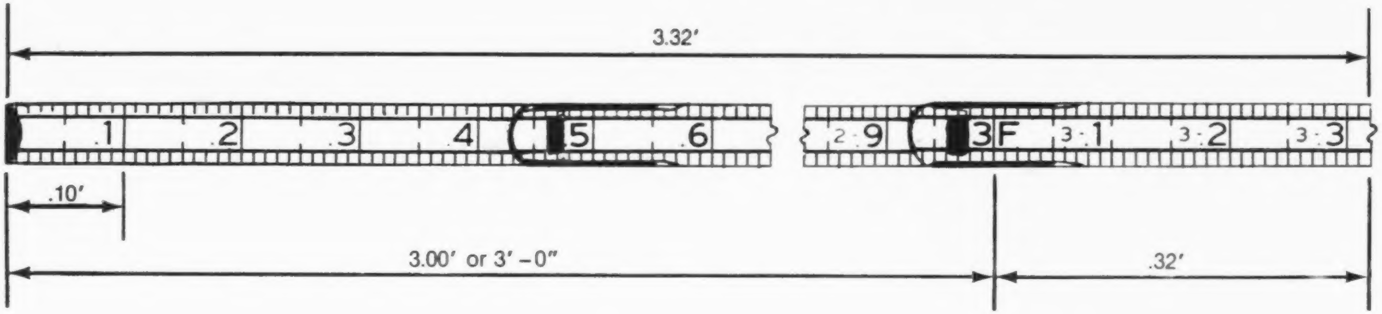
EXAMPLE 1: The rule below shows a measurement of 115 hundredths of a foot, or 1.15′.

FIGURE 17


1.15′
.1
.2
.3
.4
5
.6
.7
.8
.9
1F
1.1
.10′
1.00′ or 1′–0″
.15′

EXAMPLE 2: The rule below shows a measurement of 332 hundredths of a foot, or 3.32′.

FIGURE 18

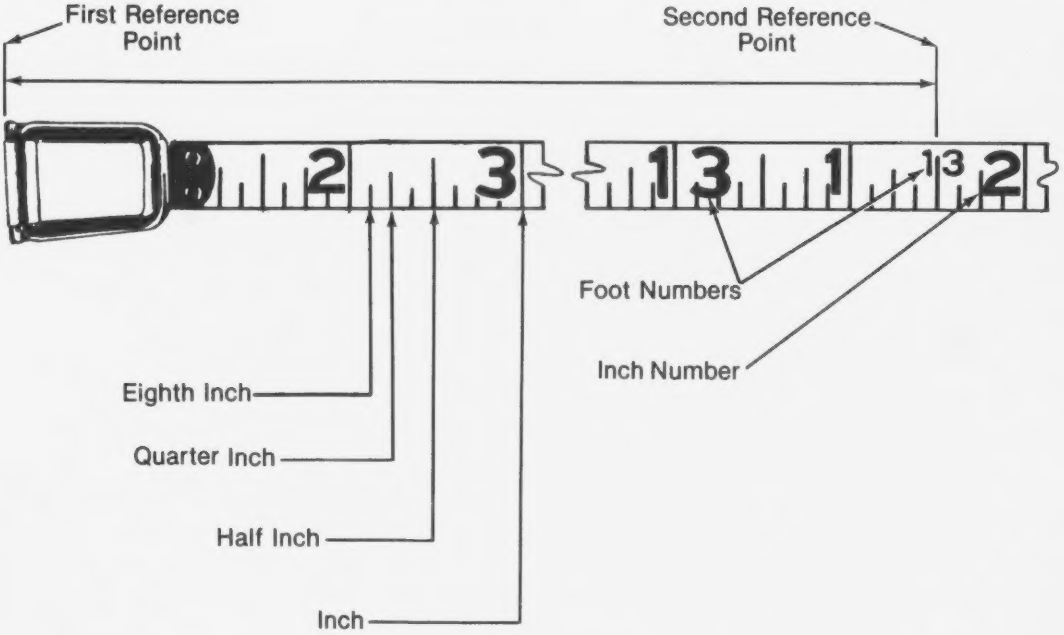

3.32′
.1
.2
.3
.4
5
.6
2.9
3F
3.1
3.2
3.3
.10′
3.00′ or 3′–0″
.32′

INFORMATION SHEET

IX. Graduations on a tape (Figure 19)

(NOTE: The graduations on tapes are the same as the various graduations on rules, but because tapes are used to measure long distances, most tapes contain running-foot indicators.)

FIGURE 19


First Reference Point
Second Reference Point
2
3
13
1
13
2
Foot Numbers
Inch Number
Eighth Inch
Quarter Inch
Half Inch
Inch

(NOTE: The tape in Figure 19 reads thirteen feet and one and one-half inches [13′ – 1½″] at the second reference point.)

X. Reading a tape to the nearest fraction of an inch

A. Place end of tape on one reference point

B. Reading from starting end of tape, determine number of feet to second reference point

C. Determine number of inches between last whole-foot mark and second reference point

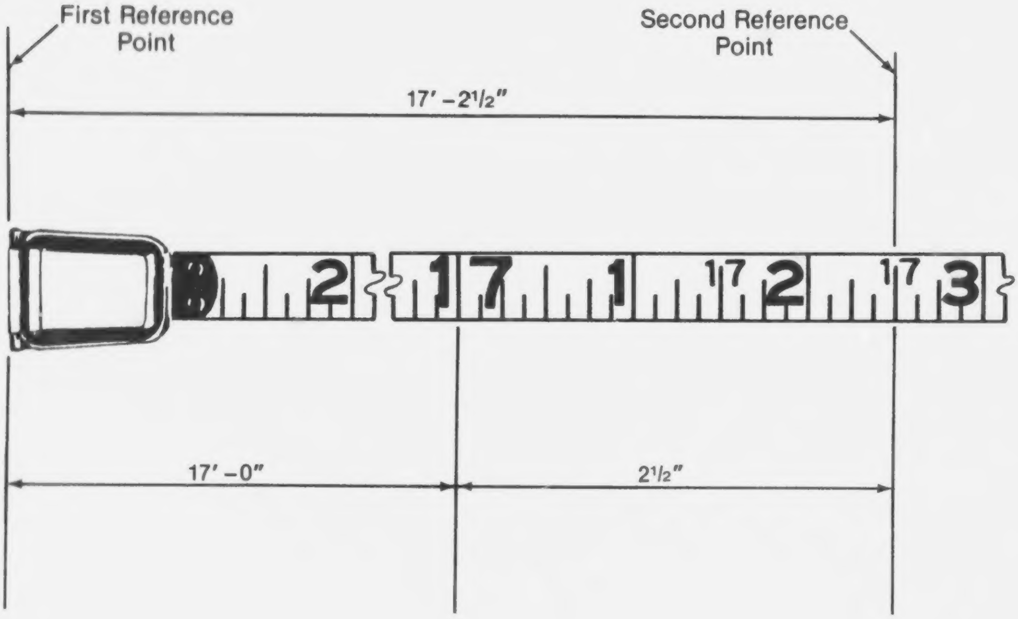
D. Determine fractional inches between last whole-inch mark and second reference point

INFORMATION SHEET

E. Add feet, inches, and fraction of an inch to obtain correct measurement (Figure 20)

EXAMPLE: The tape below reads seventeen feet two and one-half inches (17′ – 2½″) at the second reference point.

FIGURE 20


First Reference Point
Second Reference Point
17′ – 2½″
2
17
1
17
2
17
3
17′ – 0″
2½″

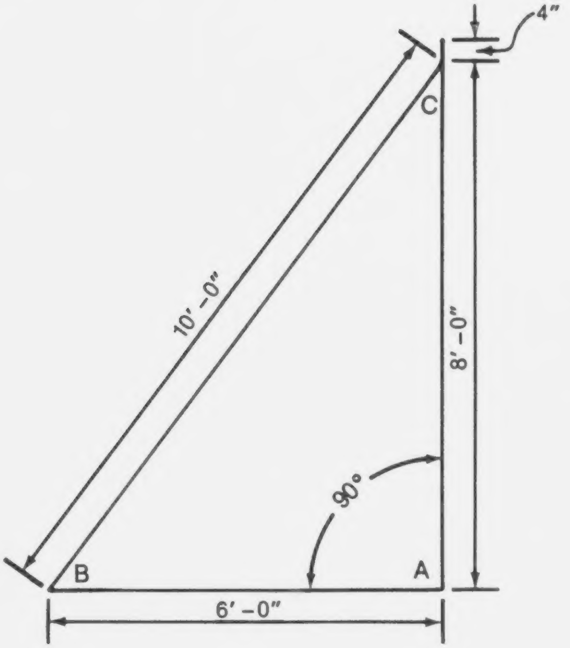
XI. Measuring methods used to square lines

A. 3-4-5 method — Forming a right triangle using largest multiple of 3-4-5 feet (6-8-10, 12-16-20, 24-32-40, etc.) possible for length of lines being squared, and ensuring that longest side of triangle is exact appropriate multiple of 5 (See Figure 21)

INFORMATION SHEET

EXAMPLE: Use the 3-4-5 method to square form corners.

FIGURE 21



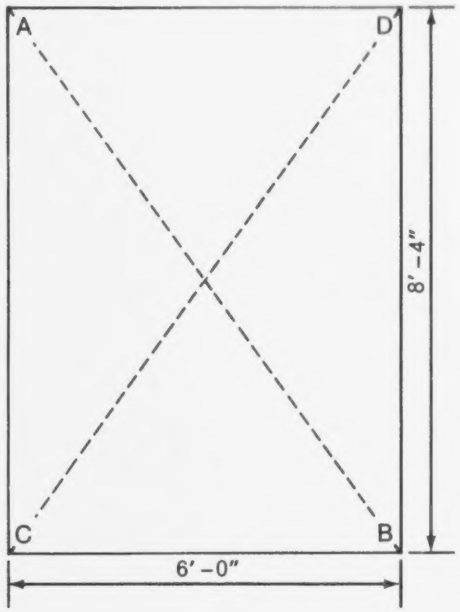
1. Measure 6 feet from Point A to Point B; mark
2. Measure 8 feet from Point A to Point C; mark
3. Measure from Point B to Point C
4. If the lines are square, measurement from Point B to Point C will be exactly 10 feet; if the measurement is not exactly 10 feet, adjust one of the lines

B. Diagonal method — Measuring diagonally from inside corners of layout and ensuring that diagonal lines are equal in length (See Figure 22)

INFORMATION SHEET

EXAMPLE: Use the diagonal method to square form corners.

FIGURE 22



1. Measure diagonally from Point A to Point B
2. Record this measurement
3. Measure diagonally from Point C to Point D
4. Record this measurement
5. If lines are square, both diagonal measurements (AB and CD) will be exactly the same; if they are not exactly the same, adjust one of the lines

MEASURING
UNIT II

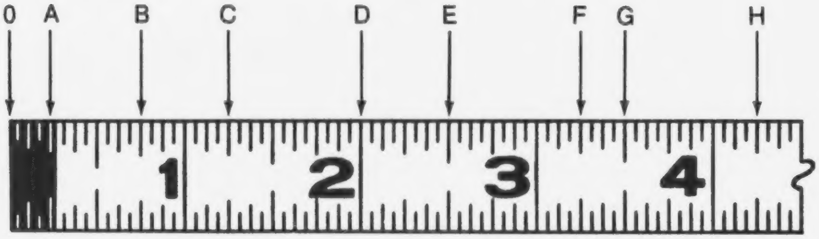
ASSIGNMENT SHEET #1 — READ MEASUREMENTS ON RULES

NAME ______________________ SCORE __________

The first step in being able to make accurate measurements is to become familiar with the graduations on rules and how to read them. This assignment sheet will allow you to practice reading measurements on rules.

PART I

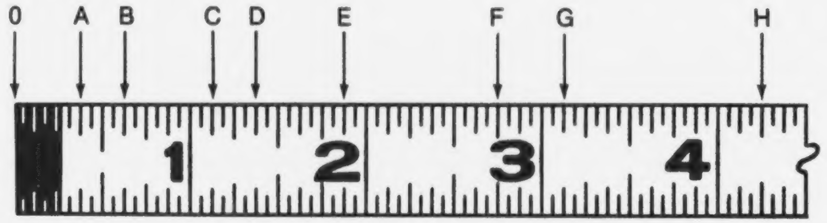
A. Read the folding rule illustrated below to the nearest quarter inch. Write your answers on the lines provided.



1. 0 to A = ______________
2. A to B = ______________
3. 0 to C = ______________
4. A to D = ______________
5. B to D = ______________
6. 0 to E = ______________
7. C to E = ______________
8. B to F = ______________
9. D to G = ______________
10. A to H = ______________

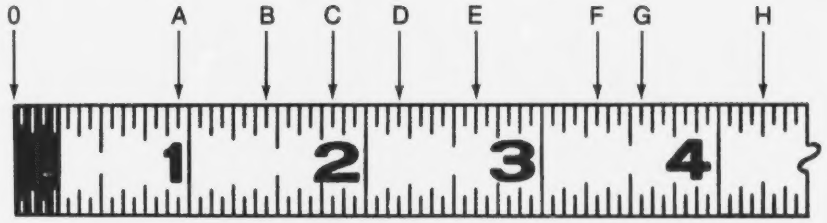
ASSIGNMENT SHEET #1

B. Read the folding rule illustrated below to the nearest eighth inch. Write your answers on the lines provided.



1. 0 to A = ____________________
2. A to B = ____________________
3. 0 to C = ____________________
4. B to D = ____________________
5. A to E = ____________________
6. 0 to F = ____________________
7. D to F = ____________________
8. C to G = ____________________
9. A to H = ____________________
10. E to H = ____________________

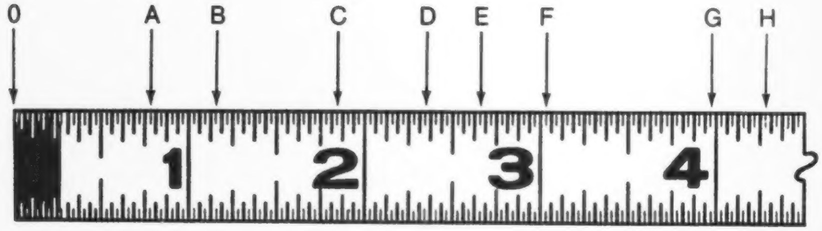
C. Read the folding rule illustrated below to the nearest sixteenth inch. Write your answers on the lines provided.



1. 0 to A = ____________________
2. A to B = ____________________
3. 0 to C = ____________________
4. B to D = ____________________
5. A to E = ____________________
6. 0 to F = ____________________
7. C to F = ____________________
8. A to G = ____________________
9. 0 to H = ____________________
10. E to H = ____________________

ASSIGNMENT SHEET #1

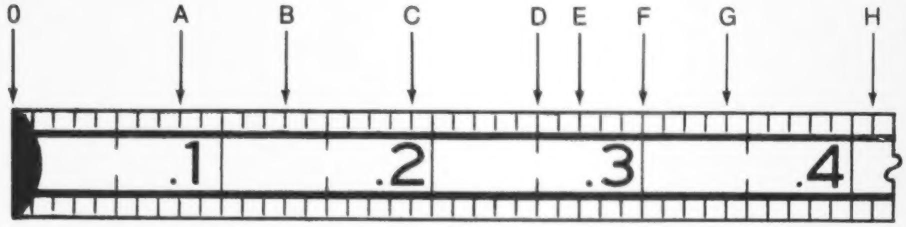
D. Read the folding rule illustrated below to the nearest one-thirty-seconds inch. Write your answers on the lines provided.



1. 0 to A = ______________________
2. 0 to B = ______________________
3. A to B = ______________________
4. 0 to C = ______________________
5. A to D = ______________________
6. B to E = ______________________
7. C to F = ______________________
8. B to G = ______________________
9. 0 to H = ______________________
10. D to H = ______________________

PART II

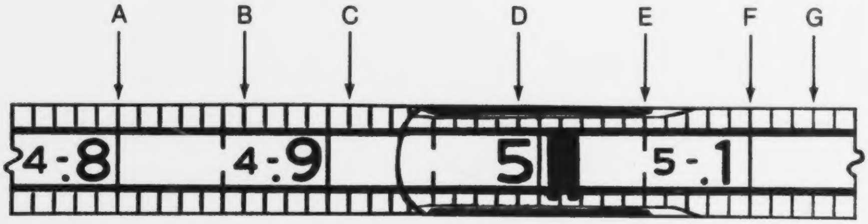
A. Read the engineer's rule illustrated below to the nearest hundredth of a foot. Write your answers on the lines provided.



1. 0 to A = ______________________
2. A to B = ______________________
3. 0 to C = ______________________
4. B to E = ______________________
5. 0 to D = ______________________
6. C to F = ______________________
7. D to G = ______________________
8. 0 to F = ______________________
9. E to H = ______________________
10. 0 to H = ______________________

ASSIGNMENT SHEET #1

B. Read the engineer's rule illustrated below to the nearest hundredth of a foot. Write your answers on the lines provided.



1. A = ____________________

2. B = ____________________

3. C = ____________________

4. D = ____________________

5. E = ____________________

6. F = ____________________

7. G = ____________________

8. A to D = ____________________

9. B to F = ____________________

10. C to G = ____________________

MEASURING
UNIT II

ASSIGNMENT SHEET #2 — MEASURE OBJECTS

NAME ______________________________ SCORE ______________

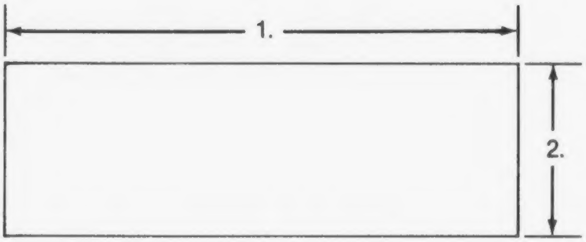
To build forms accurately, concrete masons must be able to correctly measure boards, openings, and distances. They must be able to fit forms and other parts that must be the right size and shape for proper forming. Concrete masons will use measuring skills in various phases of construction; thus, it is essential for concrete masons to master the ability to measure.

PART I

Measure the following objects, using a rule graduated in sixteenths of an inch. Write your answers in the blanks.

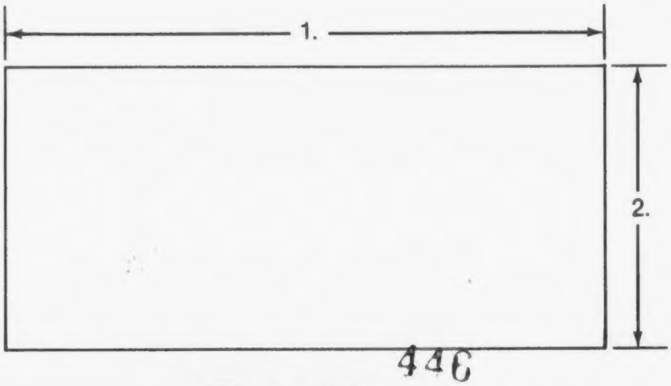
A. 1. Length = ______________

2. Height = ______________



B. 1. Length = ______________

2. Height = ______________



ASSIGNMENT SHEET #2

PART II

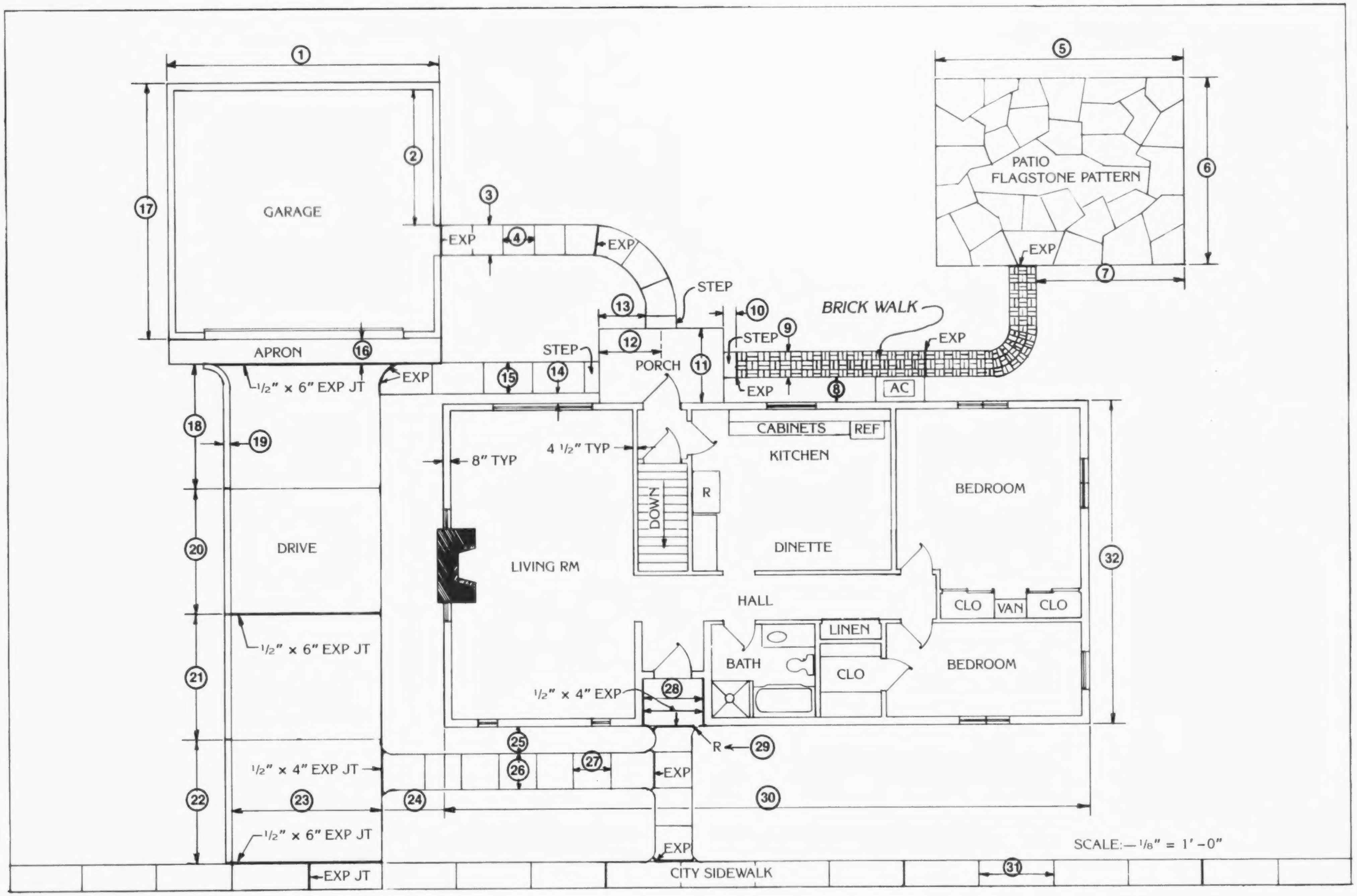
Because of the size of some projects with which concrete masons work, it may be necessary to check plans and then make *scale drawings* of the areas where forms need to be set. A scale drawing uses one dimension to represent another, and all dimensions on the drawing are reduced in the same proportion. For example, using a scale in which 1 inch on the drawing is equal to 1 foot on the actual object 4 feet high and 5 feet long, the drawing would be 4 inches by 5 inches.

A. Using a scale of 1/8 inch equals 1 foot, determine the dimensions represented on the plan on the next page. Write your answers in the blanks provided below. Dimensions may be slightly distorted due to printing.

1. = ____________________
2. = ____________________
3. = ____________________
4. = ____________________
5. = ____________________
6. = ____________________
7. = ____________________
8. = ____________________
9. = ____________________
10. = ____________________
11. = ____________________
12. = ____________________
13. = ____________________
14. = ____________________
15. = ____________________
16. = ____________________
17. = ____________________
18. = ____________________
19. = ____________________
20. = ____________________
21. = ____________________
22. = ____________________
23. = ____________________
24. = ____________________
25. = ____________________
26. = ____________________
27. = ____________________
28. = ____________________
29. = ____________________
30. = ____________________
31. = ____________________
32. = ____________________

B. Your instructor will indicate objects and structures in your shop area for you to measure. Measure the objects and write down the dimensions. Beside the dimensions, write the length that a line for that dimension would be on a drawing with a scale of 1/4 inch equals 1 foot.

ASSIGNMENT SHEET #2


①
②
③
④
⑤
⑥
⑦
⑧
⑨
⑩
⑪
⑫
⑬
⑭
⑮
⑯
⑰
⑱
⑲
⑳
㉑
㉒
㉓
㉔
㉕
㉖
㉗
㉘
㉙
㉚
㉛
㉜
GARAGE
EXP
PATIO
FLAGSTONE PATTERN
STEP
BRICK WALK
PORCH
APRON
1/2" × 6" EXP JT
AC
CABINETS
REF
KITCHEN
8" TYP
4 1/2" TYP
DOWN
R
BEDROOM
DRIVE
LIVING RM
DINETTE
HALL
CLO
VAN
LINEN
BATH
1/2" × 4" EXP
1/2" × 4" EXP JT
CITY SIDEWALK
EXP JT
SCALE:— 1/8" = 1'-0"

MEASURING
UNIT II

ASSIGNMENT SHEET #3 — CONVERT FRACTIONAL INCHES TO HUNDREDTHS OF A FOOT

NAME ____________________ SCORE __________

Many rules are marked in hundredths of a foot. Often the concrete mason is required to convert inch dimensions to decimal fractions of a foot. This exercise will help you become more proficient at converting fractional inches to hundredths of a foot.

Using the three guidelines below, convert the following inch dimensions to hundredths of a foot. Show your work.

- Consider each 12 inches to be equal to 1.00 foot
- Consider each 1/8 inch to be equal to 0.01 foot
- Add 0.01 foot for 2 inches, 0.02 foot for 5 inches, 0.03 foot for 8 inches, and 0.04 foot for 11 inches

EXAMPLE: Convert 6′ – 4 1/8″ to hundredths of a foot.

a. 6′ = 6.00

b. 4 1/8″ = 33/8 = 0.33

c. Add 0.01

d.
$$\begin{array}{r} 6.00 \\ 0.33 \\ +0.01 \\ \hline 6.34' \end{array}$$

A. 1/4″ = ____________________

ASSIGNMENT SHEET #3

B. 14′ – 5 1/2″ = ______________________

C. 3/4″ = ______________________

D. 6 5/8″ = ______________________

E. 1 3/8″ = ______________________

F. 7′ – 7 1/8″ = ______________________

ASSIGNMENT SHEET #3

G. 2 7/8″ = ____________________

H. 2′ – 8″ = ____________________

I. 4″ = ____________________

J. 11 3/8″ = ____________________

MEASURING
UNIT II

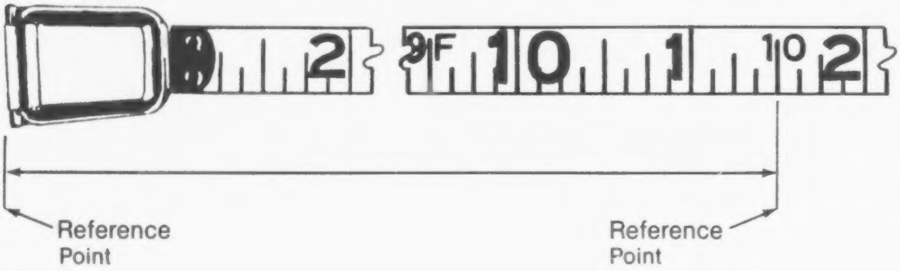
ASSIGNMENT SHEET #4 — READ MEASUREMENTS ON TAPES

NAME ______________________________ SCORE ______________

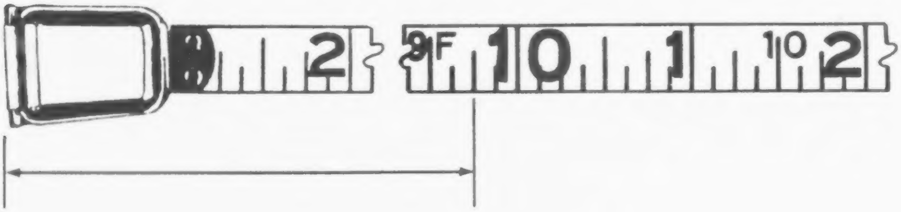
This exercise will help you to develop a better knowledge of reading a tape and will help you to read a tape quickly and efficiently.

Using the procedures outlined in Section X of the information sheet, read the following tapes and write the correct dimensions on the lines between the reference points.

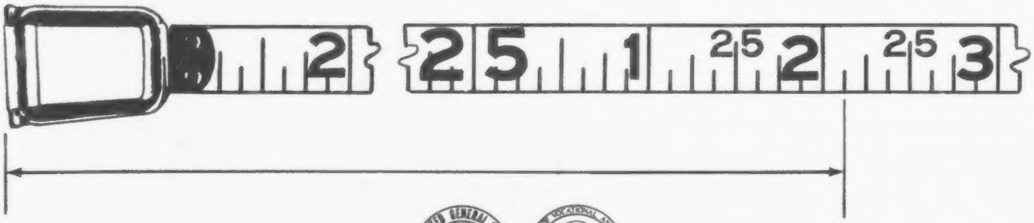
A.


2
3F
10
1
10
2
Reference Point
Reference Point

B.

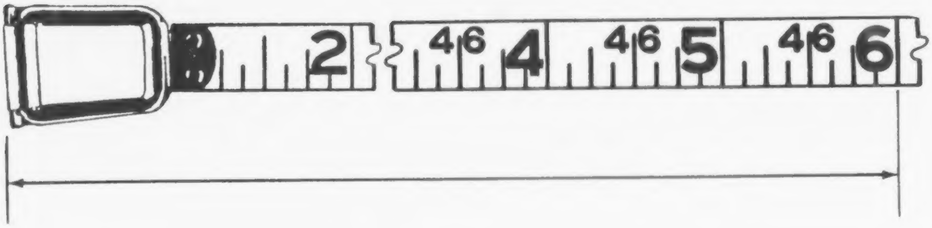


C.

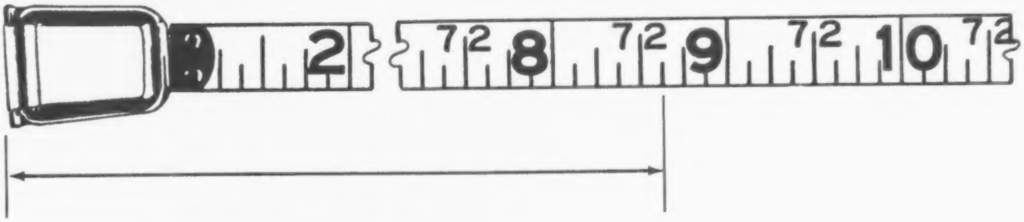

2
25
1
25
2
25
3

ASSIGNMENT SHEET #4

D.


2
4
6
4
4
6
5
4
6
6

E.


2
7
2
8
7
2
9
7
2
10
7
2

MEASURING
UNIT II

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

PART I

A. 1. 1/4"
2. 1/2"
3. 1 1/4"
4. 1 3/4"
5. 1 1/4"
6. 2 1/2"
7. 1 1/4"
8. 2 1/2"
9. 1 1/2"
10. 4"

B. 1. 3/8"
2. 1/4"
3. 1 1/8"
4. 3/4"
5. 1 1/2"
6. 2 3/4"
7. 1 3/8"
8. 2"
9. 3 7/8"
10. 2 3/8"

C. 1. 15/16"
2. 1/2"
3. 1 13/16"
4. 3/4"
5. 1 11/16"
6. 3 5/16"
7. 1 1/2"
8. 2 5/8"
9. 4 1/4"
10. 1 5/8"

D. 1. 25/32"
2. 1 5/32"
3. 3/8"
4. 1 27/32"
5. 1 9/16"
6. 1 1/2"
7. 1 3/16"
8. 2 13/16"
9. 4 9/32"
10. 1 15/16"

PART II

A. 1. 0.08′
2. 0.05′
3. 0.19′
4. 0.14′
5. 0.25′
6. 0.11′
7. 0.09′
8. 0.30′
9. 0.14′
10. 0.41′

B. 1. 4.80′
2. 4.86′
3. 4.91′
4. 4.99′
5. 5.05′
6. 5.10′
7. 5.13′
8. 0.19′
9. 0.24′
10. 0.22′

Assignment Sheet #2

PART I

A. 1. 2 15/16"
2. 1"

B. 1. 3 7/16"
2. 1 5/8"

PART II

A. 1. 22′-0"
2. 7′-0"
3. 2′-6"
4. 2′-6"
5. 20′-0"
6. 15′-0"
7. 12′-0"
8. 2′-0"
9. 2′-0"
10. 1′-0" or 12"
11. 6′-0"
12. 5′-0"
13. 3′-9"
14. 10′
15. 2′-6"
16. 2′-0"
17. 20′-8"
18. 10′-0"
19. 6"
20. 10′-0"
21. 10′-0"
22. 10′-0"
23. 12′-0"
24. 5′-0"
25. 2′-0"
26. 3′-0"
27. 3′-0"
28. 5′-0"
29. 1′R or 12"R
30. 52′-0"
31. 6′-0"
32. 26′

B. Evaluated to the satisfaction of the instructor

Assignment Sheet #3

A. 0.02′
B. 14.46′
C. 0.06′
D. 0.55′
E. 0.11′
F. 7.59′
G. 0.24′
H. 2.67′
I. 0.33′
J. 0.95′

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #4

A. 10′ – 1½″
B. 9′ – 11¾″
C. 25′ – 2⅛″
D. 46′ – 6″
E. 72′ – 8⅝″

MEASURING
UNIT II

JOB SHEET #1 — USE BASIC MEASURING TOOLS AND THE 3-4-5 METHOD TO LAY OUT THE PERIMETER OF A BUILDING ON A CONCRETE SLAB

I. Equipment and materials

   A. Floor plan at end of job sheet (See Figure 28)

   B. Two 50-foot or 100-foot tapes

   C. Chalk line

   D. Pencil

   E. Keel

II. Procedure

(NOTE: Reference Point A on concrete slab will be designated by the instructor.)

   A. Establish point for south wall (Point B, Figure 23)

      1. Have an assistant hold one end of a tape exactly on Point A (southwest corner of the building)

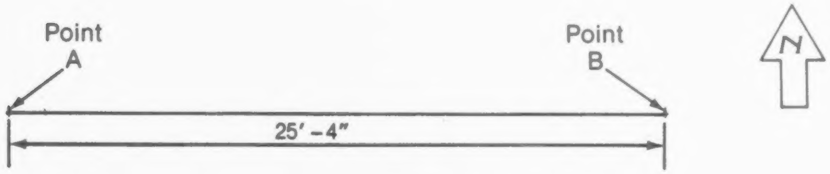
      2. From Point A, stretch tape for south wall to approximately 26 feet; mark on concrete at exactly 25 feet 4 inches (Point B)

      (NOTE: Use keel to circle this and all marks so that they will be easy to identify.)

      3. Snap a line from Point A to Point B with chalk line

      (NOTE: Be sure to keep the chalk line taut so that the line will be straight.)

FIGURE 23

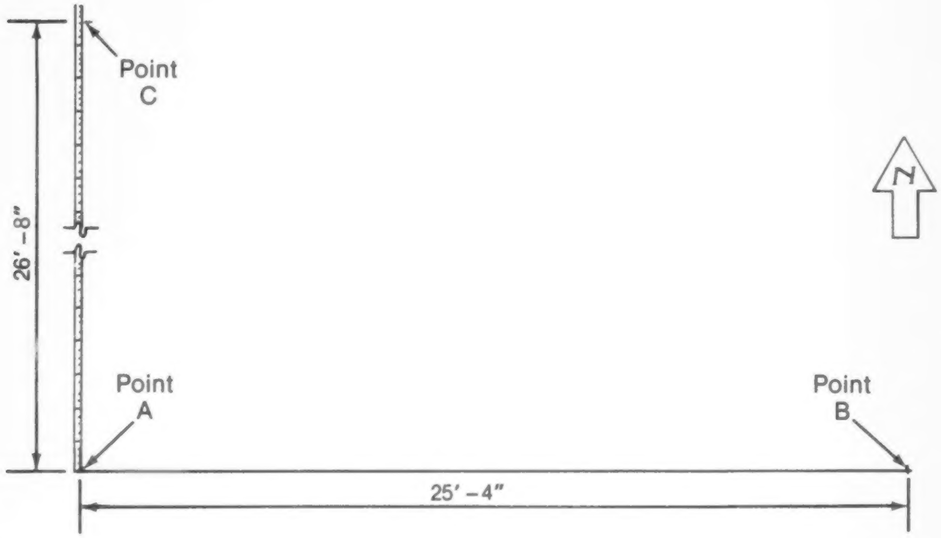


JOB SHEET #1

B. Establish point for west wall (Point C, Figure 24)

1. Have an assistant hold end of a tape exactly on Point A
2. Stretch tape for west wall to approximately 27 feet; mark on concrete at exactly 26 feet 8 inches (Point C)

FIGURE 24



C. Before snapping chalk line for the west wall (Line AC), use the 3-4-5 method to ensure that the line for this wall will be perpendicular to Line AB (See Figure 25)

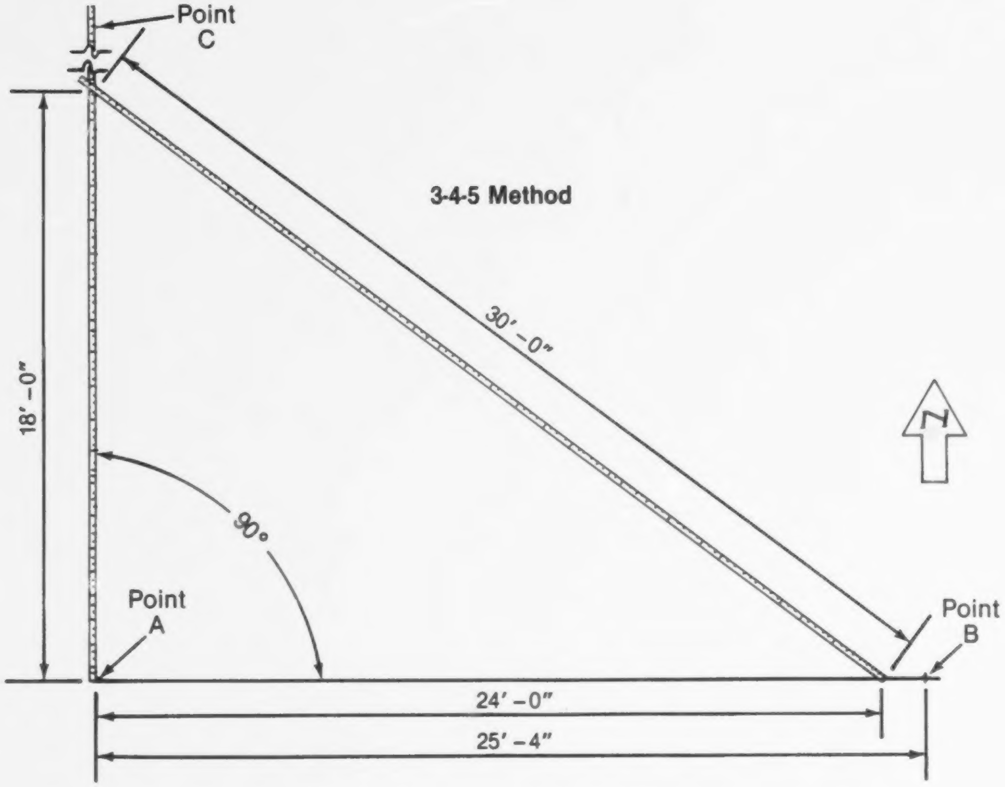
(NOTE: In this particular project, the multiples of 18-24-30 are used.)

1. Starting at Point A, measure to exactly 24 feet on Line AB; mark this point on the concrete
2. Have an assistant place end of one tape exactly on Point A; keeping tape at a right angle to Line AB, stretch tape to 18 feet
3. Have another assistant place end of a second tape exactly on the 24-foot mark on Line AB; pull second tape, at an angle, from the 24-foot mark on Line AB to the 18-foot graduation on the first tape

JOB SHEET #1

4. Adjust the two tapes until the 30-foot graduation on the second tape crosses the 18-foot graduation on the first tape; mark this point on the concrete and remove both tapes

FIGURE 25



D. Snap a line from Point A to Point C with chalk line, making sure that line passes directly through point where 18-foot and 30-foot measurements crossed

E. Establish point for east and north walls (Point D) (See Figure 26)

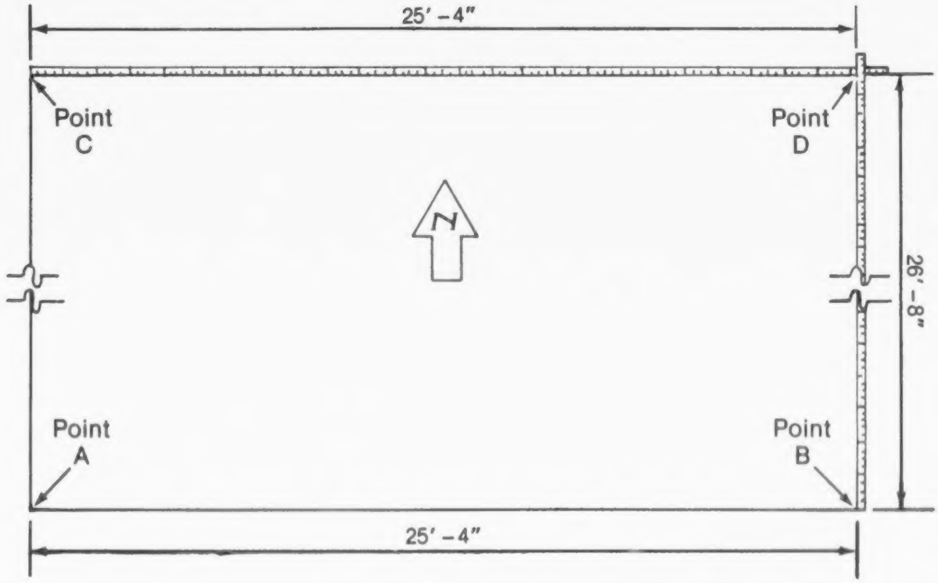
   1. Have an assistant place end of one tape exactly on Point B; stretch tape for east wall to 26 feet 8 inches (Point D)

   2. Have another assistant place end of a second tape exactly on Point C; stretch tape for north wall to 25 feet 4 inches (Point D)

   3. Adjust tapes until 26-foot 8-inch graduation on the first tape crosses the 25-foot 4-inch graduation on the second tape; mark this point (Point D) on the concrete and remove both tapes

JOB SHEET #1

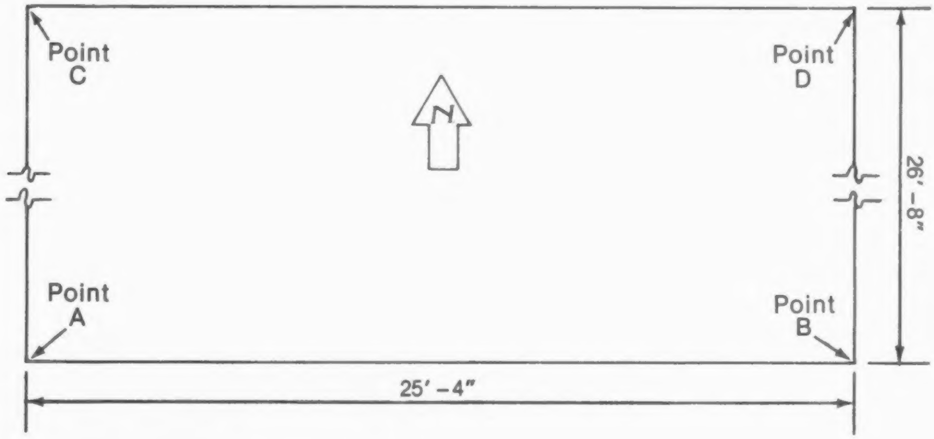
FIGURE 26


25' – 4"
Point C
Point D
N
26' – 8"
Point A
Point B
25' – 4"

F. Snap lines from Points C to D and B to D with chalk line

(NOTE: You have now established the perimeter of the building. See Figure 27.)

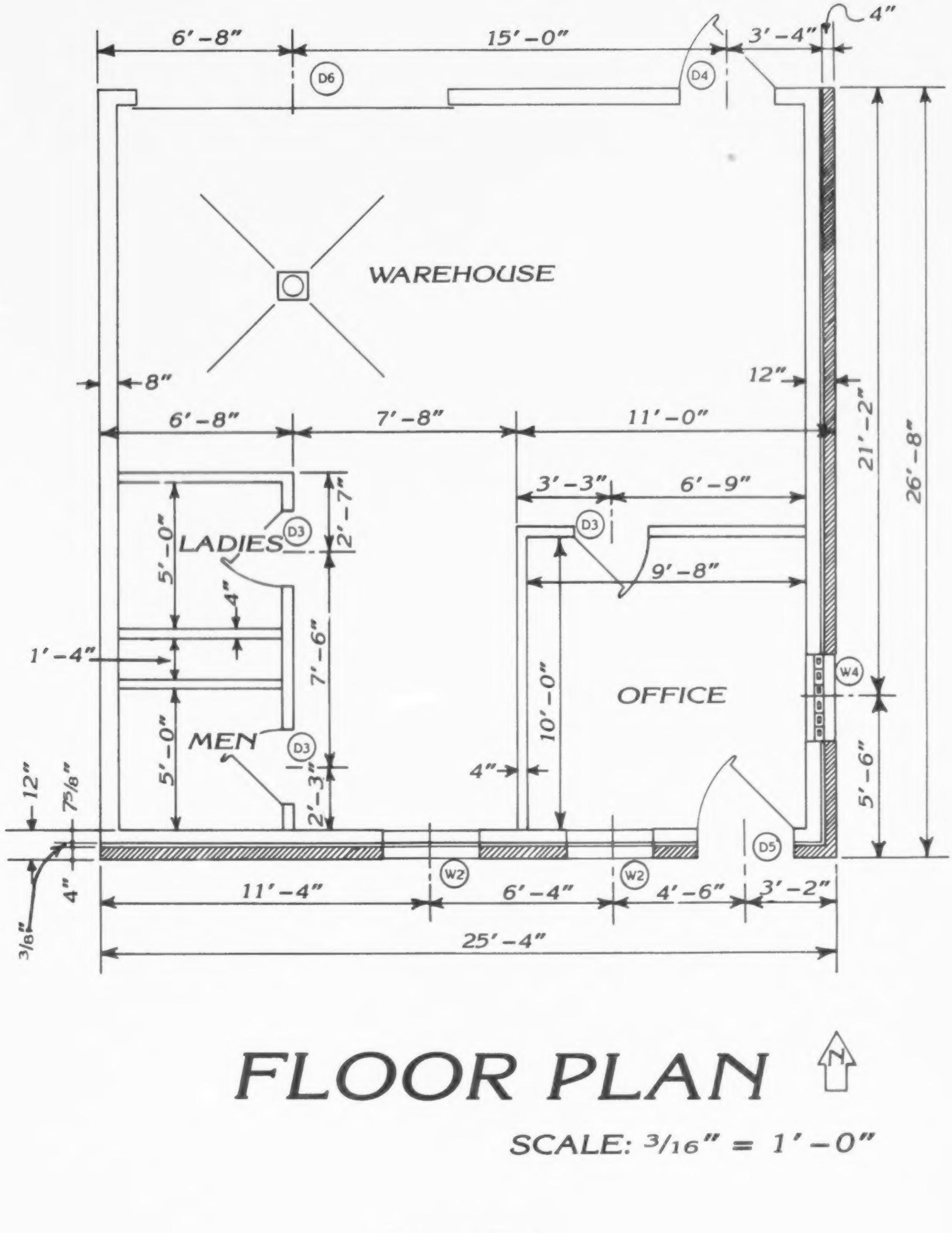
FIGURE 27


Point C
Point D
N
26' – 8"
Point A
Point B
25' – 4"

G. Clean up work area and put away equipment and materials, or measure and lay out inside dimensions shown on floor plan as directed by your instructor

JOB SHEET #1

FIGURE 28


6'-8"
15'-0"
3'-4"
4"
D6
D4
WAREHOUSE
8"
12"
21'-2"
26'-8"
6'-8"
7'-8"
11'-0"
3'-3"
6'-9"
D3
LADIES
5'-0"
2'-7"
D3
9'-8"
4"
1'-4"
7'-6"
10'-0"
OFFICE
W4
MEN
D3
5'-0"
4"
2'-3"
5'-6"
12"
7 5/8"
D5
W2
W2
4"
3/8"
11'-4"
6'-4"
4'-6"
3'-2"
25'-4"

FLOOR PLAN

SCALE: 3/16" = 1'-0"

MEASURING
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Match terms and definitions associated with measuring. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a. Arrangement of lines to indicate the actual size for constructing the object or structure represented
1. Measures
2. Dimensions
3. Divisions

_____b. Parts or sections that make up 1 inch on a rule
1. Divisions
2. Fractions
3. Graduations

_____c. Unit of measure consisting of twelve equal parts called *inches*
1. Foot
2. Inch
3. Rule

_____d. Part of a whole; represents one or more equal parts of a unit
1. Graduation
2. Fraction
3. Division

_____e. Smallest whole unit of lineal measure commonly used
1. Inch
2. Fraction
3. Foot

_____f. Type of colored marking crayon used in construction
1. Pencil
2. Felt-tip pen
3. Keel

_____g. Plan or design of the project to be constructed
1. Perimeter
2. Layout
3. Division

_____h. Relating to, consisting of, or resembling a straight line
1. Taut
2. Lineal
3. Layout

TEST

_____i. Setting of limits or bounds according to a predetermined standard

1. Measuring
2. Graduating
3. Dividing

_____j. Outer limits or boundaries

1. Layout
2. Line
3. Perimeter

_____k. Measuring instrument graduated in whole units and fractions of units

1. Rule
2. Keel
3. Foot

_____l. Tightly stretched; not slack

1. Level
2. Taut
3. Plumb

_____m. Marks on a rule or tape indicating measurements

1. Divisions
2. Dimensions
3. Graduations

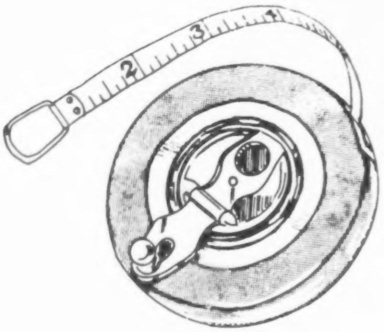
---

2. Identify the following basic measuring tools used by concrete masons. Write the correct names in the blanks.

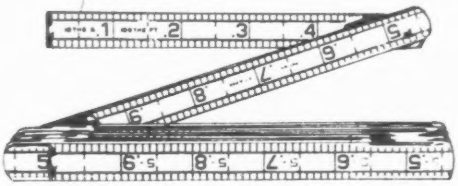
Steel tape
One-hundred-foot steel tape
Spring-balanced tape-tension handle

Speed square
Engineer's folding rule
Steel framing square

Folding rule
Combination square
Two-hundred-foot steel tape and reel

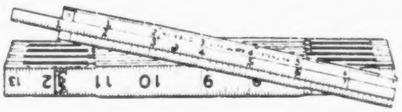


a. ______________________________

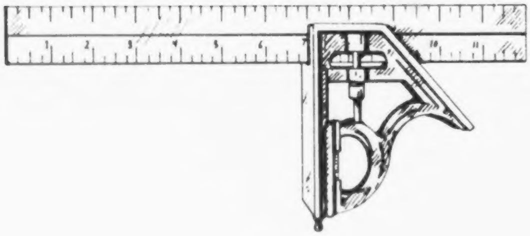


b. ______________________________

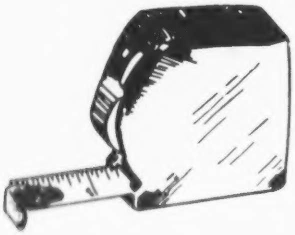
TEST



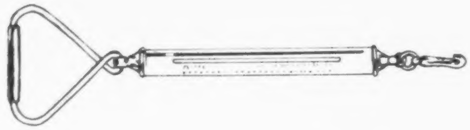
c. ______________________________



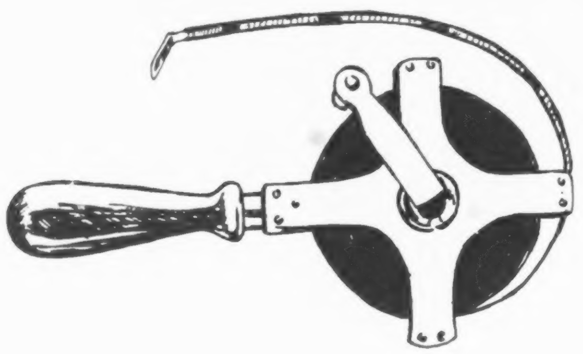
d. ______________________________



e. ______________________________

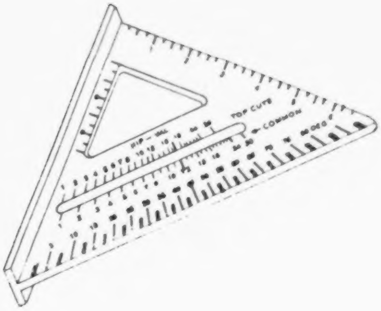


f. ______________________________

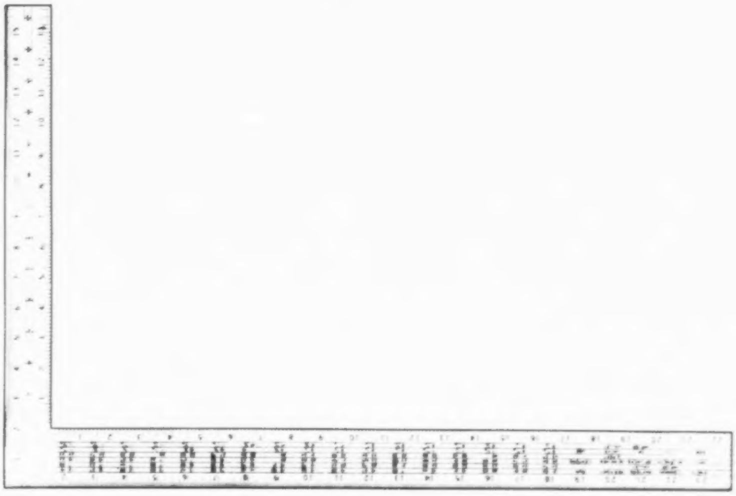


g. ______________________________

TEST


TOP CUTS
COMMON
HIP - VAL
DEGREES

h. ______________________________



i. ______________________________

3. List five common errors that contribute to incorrect measurements.

a. ______________________________

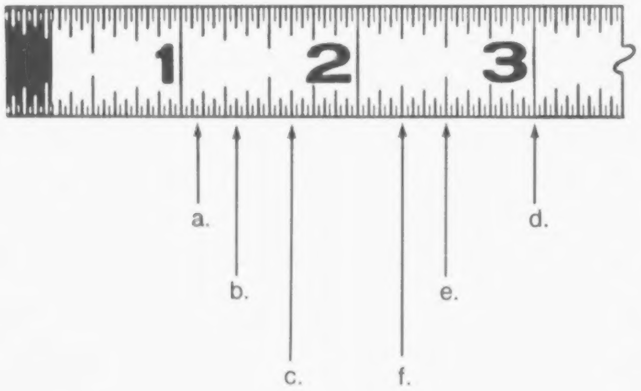
b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

4. Identify graduations on the folding rule illustrated below. Write the correct names in the blanks.



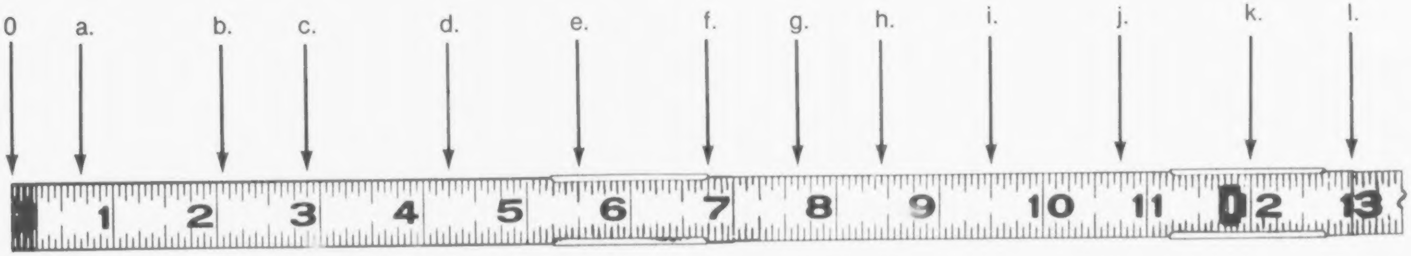
a. ______________________ b. ______________________

c. ______________________ d. ______________________

e. ______________________ f. ______________________

TEST

5. Read the folding rule illustrated below to the nearest fraction of an inch. Start each reading from the 0 end of the rule. Write the correct graduations in the corresponding blanks.


0
a.
b.
c.
d.
e.
f.
g.
h.
i.
j.
k.
l.
1
2
3
4
5
6
7
8
9
10
11
12
13

a. ____________________ b. ____________________

c. ____________________ d. ____________________

e. ____________________ f. ____________________

g. ____________________ h. ____________________

i. ____________________ j. ____________________

k. ____________________ l. ____________________

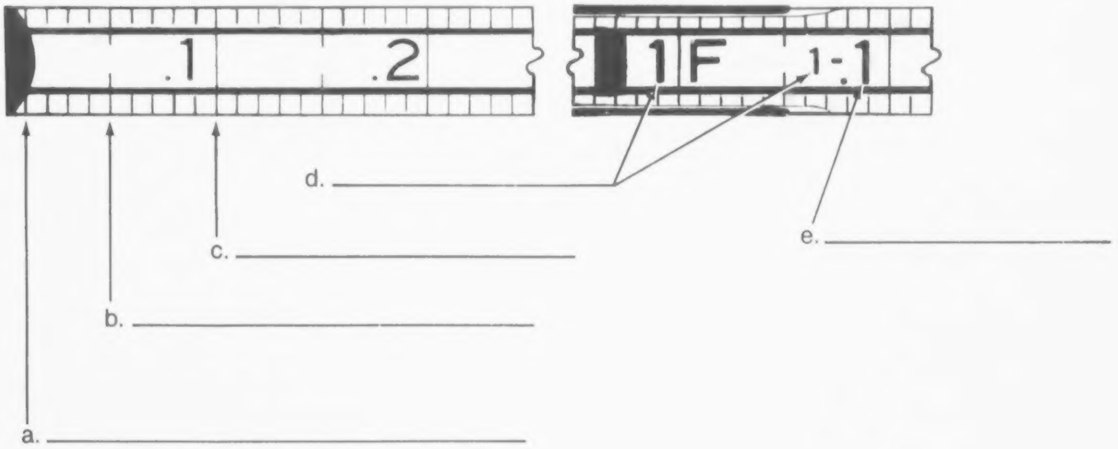
TEST

6. Convert the following fractional inches to hundredths of a foot. Write the correct answers in the blanks. Show your work.

__________a. 1/8″ __________b. 1 7/8″ __________c. 6 5/8″

__________d. 1″ __________e. 2 3/8″ __________f. 11 1/2″

7. Identify graduations on the engineer's rule illustrated below. Write the correct names in the blanks.



d. __________________________

e. __________________________

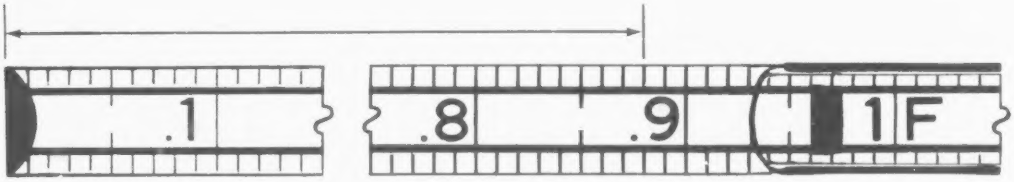
c. __________________________

b. __________________________

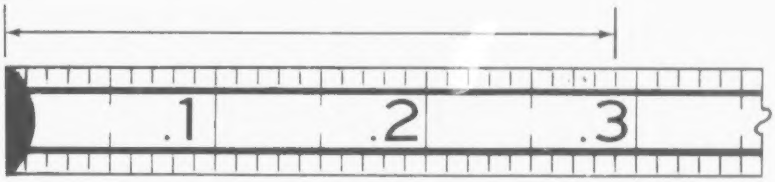
a. __________________________

TEST

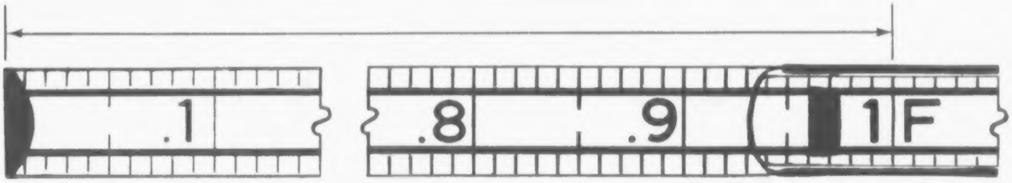
8. Read the engineer's rules illustrated below to the nearest hundredths of a foot. Write the correct answers in the blanks.



a. ____________________

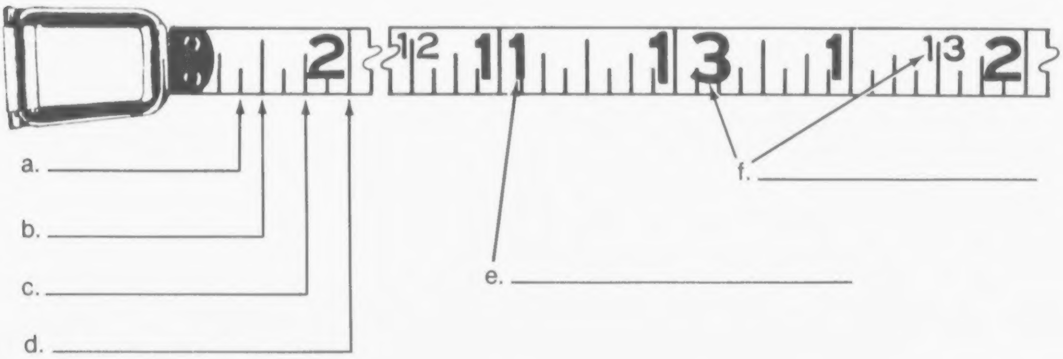


b. ____________________



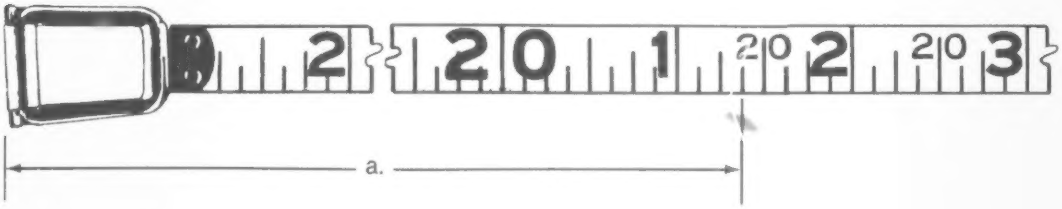
c. ____________________

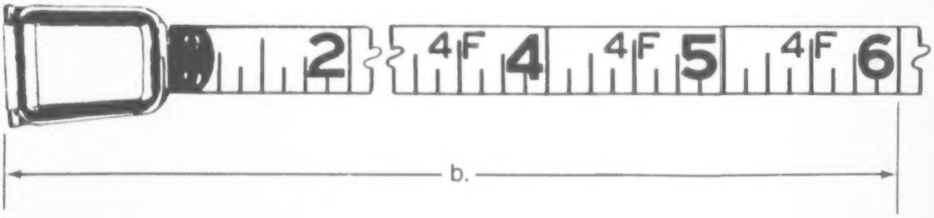
9. Identify graduations on the tape illustrated below. Write the correct names in the blanks.

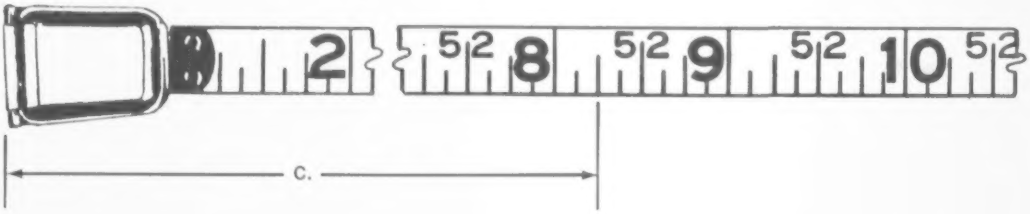

2
1 2
1 1
1
3
1
1 3
2
a.
b.
c.
d.
e.
f.

TEST

10. Read the tapes illustrated below to the nearest fraction of an inch. Write the dimensions on the arrows between the reference lines.


2
20
1
20
2
20
3
a.


2
4F
4
4F
5
4F
6
b.


2
52
8
52
9
52
10
52
c.

11. Describe measuring methods used to square lines.

a. 3-4-5 method — ______________________________

____

____

____

TEST

b. Diagonal method — ______________________________

____

____

____

(NOTE: Test items 12 and 13 list the assignment and job sheets that are considered an important part of this test. If they have not been completed, check with your instructor.)

12. Measure objects.

13. Demonstrate the ability to use basic measuring tools and the 3-4-5 method to lay out the perimeter of a building on a concrete slab.

MEASURING
UNIT II

ANSWERS TO TEST

1. a. 2
   b. 1
   c. 1
   d. 2
   e. 1
   f. 3
   g. 2
   h. 2
   i. 1
   j. 3
   k. 1
   l. 2
   m. 3

2. a. One-hundred-foot steel tape
   b. Engineer's folding rule
   c. Folding rule
   d. Combination square
   e. Steel tape
   f. Spring-balanced tape-tension handle
   g. Two-hundred-foot steel tape and reel
   h. Speed square
   i. Steel framing square

3. Answer should include any five of the following.

   a. Leaving slack in tape
   b. Not laying tape flat (tape is twisted or kinked)
   c. Not aligning tape or rule properly
   d. Not placing end of tape or rule on reference point
   e. Reading incorrect number
   f. Recording incorrect number
   g. Using wrong reference point
   h. Making errors in mathematical computations
   i. Using incorrect measuring tool for job being performed

4. a. Thirty-seconds
   b. Sixteenths
   c. Eighths
   d. Inches
   e. Halves
   f. Quarters or fourths

5. a. 11/16"
   b. 2 1/16"
   c. 2 7/8"
   d. 4 1/4"
   e. 5 1/2"
   f. 6 3/4"
   g. 7 5/8"
   h. 8 7/16"
   i. 9 1/2"
   j. 10 3/4"
   k. 12" or 1'-0"
   l. 13" or 1'-1"

ANSWERS TO TEST

6. a. .01
   b. .15
   c. .55
   d. .08
   e. .20
   f. .96

7. a. Hundredths
   b. Five-hundredths
   c. Tenths
   d. Foot numbers
   e. Tenth number

8. a. .88
   b. .29
   c. 1.00 or 1′

9. a. Eighth inch
   b. Half inch
   c. Quarter inch
   d. Inch
   e. Inch number
   f. Foot numbers

10. a. 20′ – 1 3/8″
    b. 4′ – 6″ or 4 1/2′
    c. 52′ – 8 1/4″

11. Discription should include the following.

    a. 3-4-5 method — Forming a right triangle using largest multiple of 3-4-5 feet (6-8-10, 12-16-20, 24-32-40, etc.) possible for length of lines being squared, and ensuring that longest side of triangle is exact appropriate multiple of 5

    b. Diagonal method — Measuring diagonally from inside corners of layout and ensuring that diagonal lines are equal in length

12. Evaluated to the satisfaction of the instructor

13. Performance skills evaluated to the satisfaction of the instructor

BASIC PLAN READING
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to read plans and read and use an architect's scale. The student will show this ability by completing the assignment sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with plan reading to their correct definitions.
2. Match to their correct descriptions types of drawings usually included in a set of plans.
3. List information found on types of drawings in a set of plans.
4. Match lines in the alphabet of lines to their correct uses.
5. Identify lines in the alphabet of lines.
6. Identify selected architectural symbols commonly used to represent materials on plans.
7. Identify selected abbreviations commonly used on plans.
8. Match architect's conventions to their correct representations.
9. State the purposes of written specifications.
10. List basic information included in a set of written specifications pertaining to concrete.
11. Read an architect's scale.
12. Read plans.
13. Read details.
14. Read written specifications.

BASIC PLAN READING
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents
    A. Objective sheet
    B. Suggested activities
        1. Supplements
            a. Supplement #1 — Architectural Terms Commonly Found on Plans
            b. Supplement #2 — Instructions for Concentration Game
        2. Transparency Master #1 — Architect's Scale
    C. Information sheet
    D. Assignment sheet supplements
        1. Assignment Sheet Supplement #1 — Plans
        2. Assignment Sheet Supplement #2 — Specifications
    E. Assignment sheets
        1. Assignment Sheet #1 — Interpret a Drawing
        2. Assignment Sheet #2 — Read Plans
        3. Assignment Sheet #3 — Read Details
        4. Assignment Sheet #4 — Read Written Specifications
        5. Assignment Sheet #5 — Read an Architect's Scale
    F. Answers to assignment sheets
    G. Test
    H. Answers to test

II. Instructor's guide
    A. Review unit and plan presentation.
    B. Obtain materials to supplement unit.
        1. Films
        2. Sets of plans and written specifications for various structures

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

SUGGESTED ACTIVITIES

3. Examples of perspective, mechanical, and structural drawings

4. Pictures of different types of period construction

   EXAMPLES: Early American, Old English, Cape Cod, French

5. Transparencies and competency profiles

   (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street N.W., Washington, D.C. 20006; phone 202-393-2040.)

6. Architect's scales for each member of the class

7. Copy of latest edition of *Architectural Graphic Standards* by Ramsey and Sleeper

C. Make transparencies and additional copies of assignment sheets and supplements if needed.

D. Introduce unit.

SUGGESTIONS:

- Compare plan reading with planning a vacation or trip to another city using a road map.
- Ask questions about what is necessary to build a home or commercial building. Point out that plans provide detailed drawings and that plans and specifications contain all information necessary to complete a job successfully.
- Invite an architect to the class to discuss architect's drawings and plans.

E. Provide students with objective sheet; discuss unit and specific objectives.

F. Provide students with information and assignment sheets.

G. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss terms associated with plan reading.

   SUGGESTIONS:

   - Provide students with copies of Supplement #1, "Architectural Terms Commonly Found on Plans."

SUGGESTED ACTIVITIES

- When discussing nominal and actual dimensions, have students measure a concrete block, 2×4, or other piece of lumber to illustrate the difference between nominal and actual dimensions.

- Show students examples of perspective, mechanical, and structural drawings when discussing these terms.

2. Use Information Sheet, Sections II and III, to discuss the types of drawings usually included in a set of plans.

   SUGGESTIONS:

   - Have students briefly review each drawing in the set of plans in Assignment Sheet Supplement #1 so that they can recognize each type of construction plan.

     (NOTE: Students will refer to each plan in this set when studying other sections of the information sheet and when completing the assignment sheets.)

   - Show students examples of perspective, mechanical, and structural drawings.

3. Use Information Sheet, Sections IV and V, to discuss and illustrate the alphabet of lines.

   SUGGESTIONS:

   - Select a drawing from the plans in Assignment Sheet Supplement #1 at the end of the information sheet, or use one obtained to supplement the unit, and have students identify the different lines on the plan.

   - Have students complete Part II of Assignment Sheet #1, "Interpret a Drawing."

4. Use Information Sheet, Section VI, to discuss and illustrate symbols commonly used to represent materials on plans.

   SUGGESTIONS:

   - Select a drawing from the set of plans in Assignment Sheet Supplement #1, or use one obtained to supplement the unit, and have students identify symbols found on the plan.

   - Use Supplement #2, "Instructions for Concentration Game," to develop a concentration game for review of symbols.

   - Have students complete Part I of Assignment Sheet #1, "Interpret a Drawing."

SUGGESTED ACTIVITIES

5. Use Information Sheet, Section VII, to discuss abbreviations commonly used on plans.

   SUGGESTIONS:

   - Develop a set of flash cards containing the various abbreviations. Have students use the cards in teams, or show the class the cards and have individuals give you the correct answers.
   - Select a drawing from the set of plans in Assignment Sheet Supplement #1, or use one obtained to supplement the unit, and have students identify the abbreviations on it.
   - Have students complete Assignment Sheets #2 and #3, "Read Plans" and "Read Details." Critique and discuss in class.

6. Use Information Sheet, Section VIII, to discuss conventions used by architects.

   SUGGESTIONS:

   - Invite an architect to the class to discuss and demonstrate the conventions used in architect's drawings.
   - Select a drawing from the set of drawings in Assignment Sheet Supplement #1, or use one obtained to supplement the unit, to illustrate conventions.

7. Use Information Sheet, Sections IX and X, to discuss written specifications.

   SUGGESTIONS:

   - Point out that the description of materials in Assignment Sheet Supplement #2, "Specifications," is only part of a set of specifications for a particular residential building.
   - Prepare a bulletin board showing the relationships between plans and written specifications.
   - Have students complete Assignment Sheet #4, "Read Written Specifications." Critique and discuss in class.
   - Provide students with specifications for a building in your community. Discuss.
   - Invite a contractor to the class to explain how bids are made based on plans and written specifications for a building.

SUGGESTED ACTIVITIES

8. Use Information Sheet, Section XI, and Assignment Sheet #5, "Read an Architect's Scale," to discuss reading the architect's scale.

    SUGGESTIONS:

    - Provide each student with an architect's scale.
    - Use Transparency #1 to illustrate the architect's scale.
    - Have students complete Assignment Sheet #5 so that they may practice reading the different scales on an architect's scale.
    - Have students use *Architectural Graphic Standards* to learn the different dimensioning systems.

9. Visit construction sites that are in different phases of construction. Obtain construction plans so that students can read the plans to determine the next steps to be taken.

H. Give test.

I. Critique test and discuss in class.

J. Reteach if necessary.

K. Complete appropriate section of competency profiles.

III. References

A. Dalzell, Ralph J. *Blueprint Reading for Home Builders.* New York: McGraw-Hill Book Company, Inc., 1955.

B. Hendrix, Laborn J. "Bud." *Bricklaying Curriculum, Basic Core.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1983.

C. Hendrix, Laborn J. "Bud." *Millwright Instructional Materials.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1980.

D. Hepler, Donald E., and Paul J. Wallach. *Architectural Drafting and Design,* 3rd ed. New York: McGraw-Hill Book Company, Inc., 1977.

E. Ramsey, Charles G., and Harold R. Sleeper. *Architectural Graphic Standards,* 6th ed. Edited by Joseph N. Boaz. New York: John Wiley and Sons, Inc., 1970.

F. Sundberg, Elmer W. *Building Trades Blueprint Reading,* 4th ed. Chicago, Illinois: American Technical Society, 1967.

G. Wagner, Willis H. *Modern Carpentry.* South Holland, Illinois: The Goodheart-Willcox Co., Inc., 1976.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — ARCHITECTURAL TERMS COMMONLY FOUND ON PLANS

Window terms

Sill — Horizontal member at the bottom of a window or doorway

Lintel — Horizontal structural member supporting a wall over a window or other opening

Stair terms

Tread — Horizontal part of a step on which the foot is placed

Stringer — Supporting timber at sides of staircase or edge form for stairs

Riser — Vertical portion of a step

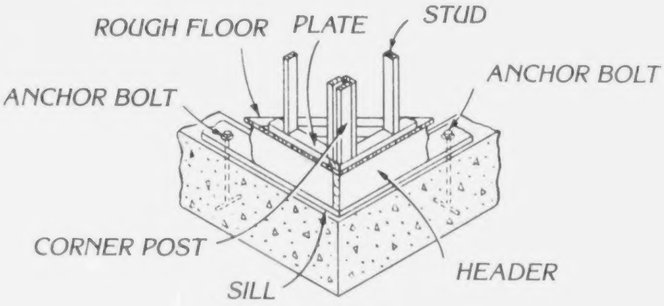
Nosing — Overhanging edge of a stair tread

Landing — Horizontal floor area between flights of steps

Run — Horizontal distance covered by a flight of steps; also net width of a step

Rise — Vertical distance from top of a tread to top of next highest tread

Structural terms



Used from *Blueprint Reading for Home Builders* by J. Ralph Dalzell, 1955, published by McGraw-Hill Book Company, Inc., New York.

Anchor bolt — Bolt with threaded portion projecting from structure; generally used to hold frame of a building secure against wind load

(NOTE: Anchor bolts may also be called *hold-down bolts, foundation bolts,* or *sill bolts.*)

SUPPLEMENT #1

Sill — Horizontal member supported by a foundation wall or piers, and which in turn bears the upright members of a frame

Plate — Structural member with a depth substantially smaller than its length or width

Stud — One of a series of vertical slender wood or metal members used to support elements in walls and partitions

Footing — Foundation for a column; enlargement at the bottom of a wall to distribute the weight of the superstructure over a greater area to prevent settling

Expansion joint — Separation between adjoining parts to allow for small relative movements such as those caused by temperature changes

Veneer — Covering layer of material for a wall; facing material applied to the external surface of steel, reinforced concrete, or frame walls

Reinforced concrete — Concrete containing metal rods, wires, or other slender members in such a manner that concrete and metal act together to resist forces

Stem wall — That portion of foundation that rests on the footing

Vapor barrier — Material used to retard the flow of vapor or moisture into walls or floor and thus prevent condensation within them

Girder — Main supporting beam, either timber or steel, used for supporting a superstructure

Furring — Strips of wood or metal applied to a wall or other surface to make it level, form an airspace, or to provide a fastening surface for a finish covering

Camber — Concave or convex curvature of a surface

Beam — One of the principal horizontal members of a building

Slab — Poured concrete floor

Monolithic — Continuous mass of concrete cast as a single unit

SUGGESTED ACTIVITIES

SUPPLEMENT #2 — INSTRUCTIONS FOR CONCENTRATION GAME

PURPOSE

Concentration provides the opportunity to eliminate the boredom of repetition in drilling students to learn the basics. It is an enjoyable classroom activity that allows students to match closely related terms and information.

(NOTE: Concentration is a classroom alternative that can be improvised with a very minimal investment of dollars and cents. The basic board can be personalized to address many group and individual learning needs in nearly every subject area.)

PREPARATION

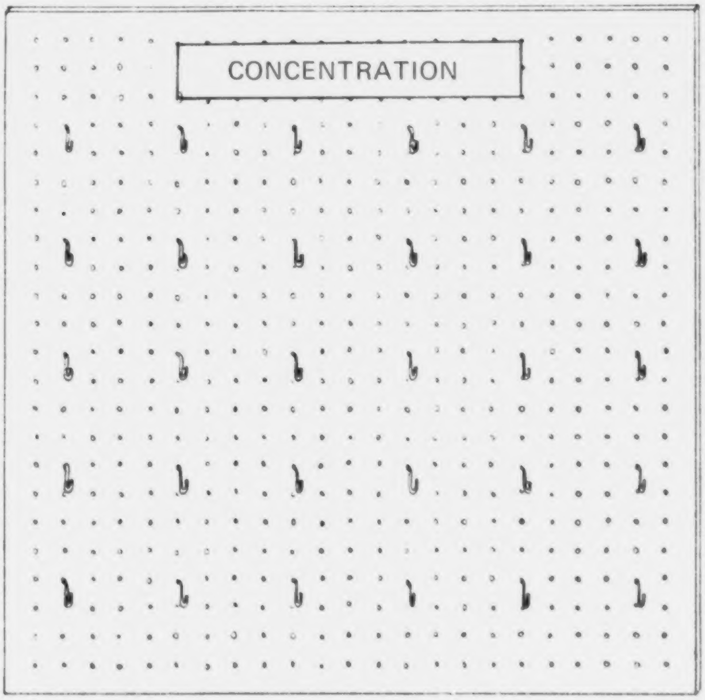
A. Gather the following materials to construct a basic Concentration board

Pegboard, 24 inches by 30 inches
Pegboard hooks, approximately 30 to 36
Poster board or index cards, all one color
Spray paint, optional
Scissors
Glue
Hole punch

B. Paint the pegboard if desired, and allow to dry

C. Write the word CONCENTRATION on a piece of poster board and glue to the top of the pegboard

D. Position the pegboard hooks



SUPPLEMENT #2

E. Cut 3-by-5-inch cards from colorful poster board (cards should all be the same color), or use unlined index cards

F. Number one side of each card from 1 to 36, or adapt to twice the actual number of terms, items, and so on that the student will identify

G. Shuffle the numbered cards to mix the numbers, and then write terms, or paste or draw shapes, objects, or pictures on the unnumbered sides of the cards

(NOTE: If you want students to match terms to their definitions, write the terms and definitions on the cards, pairing each with a symbol such as a star, circle, etc. Another option is to add two or four wild cards that will match any combination. Be sure to pair every word, shape, object, or picture. Once the cards are made, they can double as flash cards or playing cards to involve students in pairs.)

H. Punch a hole in the top of each card, and place the cards on the hooks in numerical sequence, with the numbered side showing

PLAY

A. The beginning student or team selects two numbers

EXAMPLE: 2 and 27

B. If the words, shapes, objects, or pictures match, the student or team earns a point, or has the opportunity to give a definition, or identify the object or picture to earn a point

C. If the cards match and the point is earned, the cards that match should remain turned out, with their numbers now facing the board

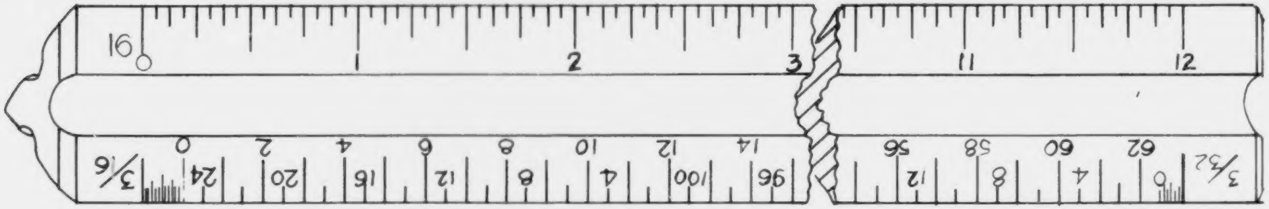
D. If the cards do not match, they are returned to their original playing position with numbers facing out, and the turn goes to the opposition

E. The game continues until the backs of all cards are revealed and matched

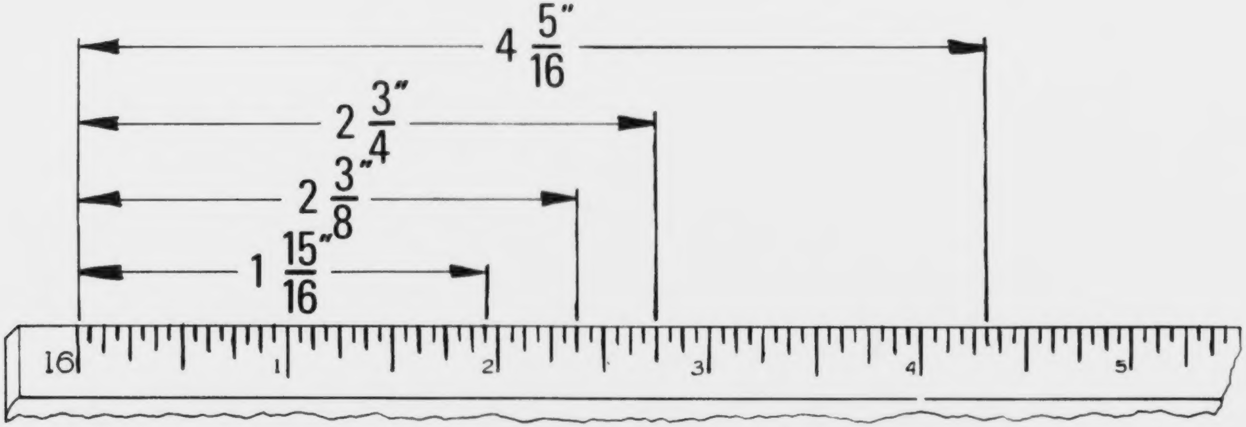
F. The student or team that provides the highest number of matches (points) wins the game

(NOTE: The instructor may want to present a reward or a token of accomplishment to the winning student or team.)

Architect's Scale


16
1
2
3
11
12
3/16
0
2
4
6
8
10
12
14
24
20
16
12
8
4
100
96
56
58
60
62
12
8
4
0
3/32

Measurements at Scale of 12" = 1'-0" (Full Scale)


4 5/16"
2 3/4"
2 3/8"
1 15/16"
16
1
2
3
4
5

BASIC PLAN READING
UNIT III

INFORMATION SHEET

I. Terms and definitions associated with plan reading

A. Architect's drawings — Set of detailed working drawings or plans drawn to scale by an architect, showing all information and dimensions necessary to build or remodel a structure; original drawings from which blueprints are made

(NOTE: The working drawings or architect's plans consist of several different kinds of drawings, usually assembled into a set: plot plan, foundation plan, floor plan[s], elevation drawings, section drawing[s], and detail drawings. The set will also include finish schedules and may include a perspective drawing, a structural drawing, and a mechanical drawing.)

B. Blueprints — Reproductions of architect's drawings; also called *plans* or *construction plans*

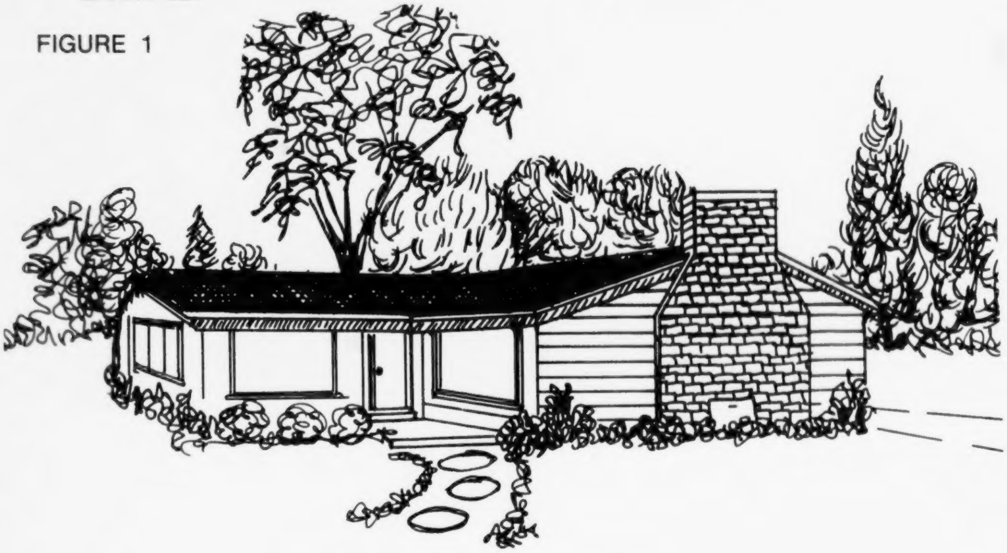
(NOTE: A true blueprint has white lines on a blue background; however, most of today's reproductions produce a black-, blue-, or sepia-colored line on a white background. See Assignment Sheet Supplement #1 at the end of the information sheet.)

C. Perspective drawing — Drawing having many of the features of a photograph; drawn by the architect to interest buyers (Figure 1)

(NOTE: Whenever perspective drawings are available, the concrete mason should use them as an aid in visualizing the many details that appear on the construction plans.)

EXAMPLE:

FIGURE 1



INFORMATION SHEET

D. Structural drawing — Drawing by a structural engineer; may accompany architect's plans and give important information about the foundation, skeleton, and floor systems

(NOTE: Structural plans are usually drawn for large structures such as an office building or factory. They include such details as heights of finished floors and walls; height and bearing of bar joist or steel joist; locations of bearing steel material; height of steel beams, concrete plank, concrete Ts, and poured-in-place concrete; bearing plate locations; location, size, and spacing of anchor bolts; and stairways.)

E. Mechanical drawing — Drawing showing location and details about plumbing and electrical components and heating and air-conditioning units

(NOTE: Mechanical features may be drawn on the basic floor or foundation plan or may be shown in separate drawings.)

F. Specifications — Detailed set of written instructions that supplements the set of plans, describes equipment and materials used in the structure, and becomes part of the contract (See Assignment Sheet Supplement #2 at end of information sheet)

G. Finish schedule — Listing or chart of parts (keyed to the plans), amounts, materials or products, and details (Figures 2 and 3)

(NOTE: Schedules may appear on the same page as a plan or on a separate page in the set of plans. Schedules may be listed for windows, doors, room finishes, floor types and finishes, paint, applicances, fixtures, lintels, headers, and reinforcing steel. See Sheet #11 in Assignment Sheet Supplement #1 at the end of the information sheet.)

EXAMPLES:

FIGURE 2

DOOR SCHEDULE FOR ENTIRE HOUSE

MARK	SIZE	AMT REQ'D	REMARKS
A	5'-0" x 6'-8" x 1¾"	1	EXTERIOR FLUSH DOOR
B	2'-8" x 6'-8" x 1¾"	7	FLUSH DOORS 1-SLIDING 1-METAL CLAD
C	2'-6" x 6'-8" x 1⅜"	4	FLUSH DOOR
C_1	2'-6" x 6'-8" x 1⅜"	2	LOUVERED
D	2'-4" x 6'-8" x 1⅜"	4	FLUSH DOOR
D_1	2'-4" x 6'-8" x 1⅜"	1	LOUVERED
E	1'-3" x 6'-8" x 1⅜"	1	BIFOLD LOUVERED
F	2'-10" x 6'-8" x 1¾"	2	EXTERIOR 2 LIGHTS
G	2'-8" x 6'-8" x 1¾"	1	EXTERIOR 2 LIGHTS

FIGURE 3

WINDOW SCHEDULE

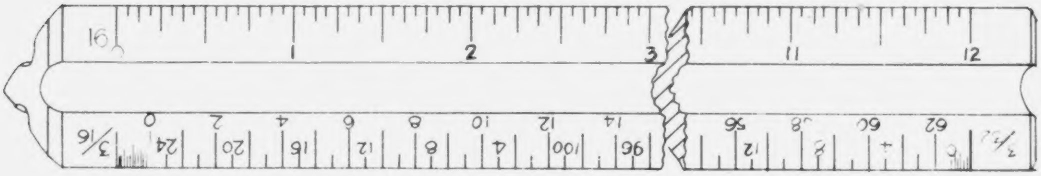
MARK	SIZE	REMARKS
A	(2) 3'-0" x 4'-2"	DH SEE SPECS
B	(2) 3'-0" x 3'-2"	"
C	—	TRIMLINE BAY 53R
D	2'-7" x 4'-2"	DH SEE SPECS
E	1'-6" x 3'-2"	"
F	2'-6" x 2'-9"	231B CASEMENT
G	3'-0" x 3'-2"	DH SEE SPECS
H	2'-0" x 5'-5"	FIXED SEE SPECS

INFORMATION SHEET

H. Architect's scale — Three-sided rule with six ruled faces designed to measure in twelve different scales of proportional feet and inches (Figure 4)

EXAMPLE:

FIGURE 4



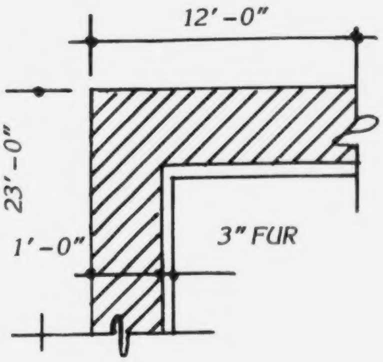
I. Scale drawing — Drawing made to a size either proportionally larger or smaller than the actual size of the object represented

(NOTE: The scale to which the architect makes a drawing is always indicated on the drawing, generally below the title. Detail and section drawings may be drawn on a larger scale than the other drawings in the set of plans.)

J. Convention — Architect's standard methods of representing dimensions and structural details (Figure 5)

EXAMPLE: Exterior solid brick wall

FIGURE 5



K. Visualization — Important aspect of plan reading that involves looking at and thinking about a structural detail, or a symbol for such a detail, and being able to form a mental picture of how such a detail is constructed or assembled

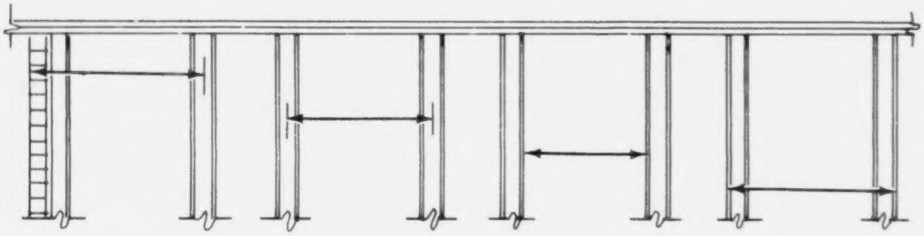
INFORMATION SHEET

L. Dimensioning — Using conventional dimension lines and figures to indicate actual sizes and distances of objects and spaces represented

(NOTE: Dimensioning may be from outside to center, center to center, wall to wall, or outside to outside. See Figure 6. In all cases, dimensions are given in full scale regardless of the fact that the plan shows an object or distance on a smaller scale. Section and detail views may use nominal sizes in labeling.)

EXAMPLE:

FIGURE 6



M. Nominal dimension — Approximate or rough size of a unit

EXAMPLES: 2×4 board, 8″ × 8″ × 16″ concrete block

N. Actual dimension — Exact measured size of a unit

EXAMPLES: A 2×4 board is actually 1½ by 3½ inches; an 8″ × 8″ × 16″ concrete block is actually 7 ⅝″ × 7 ⅝″ × 15 ⅝″.

O. Elevation — Given grade

(NOTE: The use of the word *elevation* in this sense must not be confused with the elevation of a structure, which is a view of the outside of the structure.)

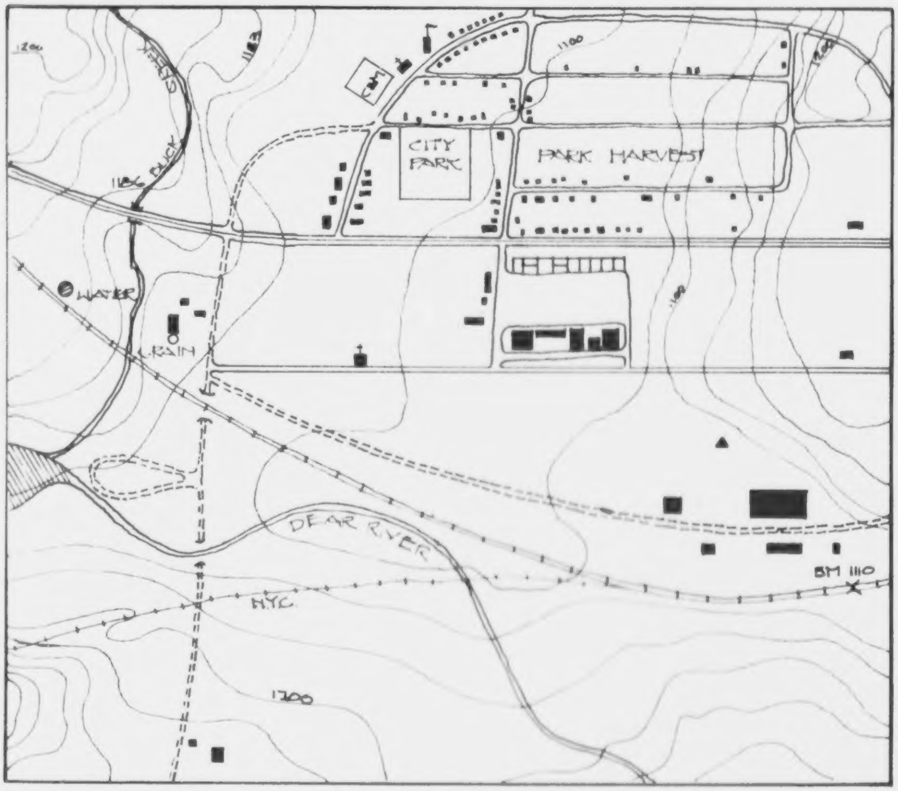
P. Benchmark — Point of known or assumed elevation used by surveyor as a reference point in determining other elevations

INFORMATION SHEET

Q. Topographical survey — Drawing of natural and man-made features of a place or region showing their relative positions and elevations (Figure 7)

EXAMPLE:

FIGURE 7


1200
CREEK
1183
CEM
1100
1200
CITY PARK
PARK HARVEST
1186 DUCK
WATER
GRAIN
1100
DEAR RIVER
N.Y.C.
BM 1110
1200

R. Contour lines — Lines used on plot plans and topographical surveys to show both natural grade and finish grade elevations (See Figure 7)

II. Descriptions of types of drawings usually included in a set of plans

A. Plot plan — Horizontal view showing where the building is to be located on the site (See Sheet #1 in Assignment Sheet Supplement #1)

B. Foundation plan — Horizontal view of entire masonry substructure below first floor or frame of building (See Sheet #2 in Assignment Sheet Supplement #1)

INFORMATION SHEET

C. Floor plan — Horizontal view of building, showing length and breadth of building and layout of rooms on that floor (See Sheet #3 in Assignment Sheet Supplement #1)

D. Elevation — Vertical, two-dimensional view of each of the exterior faces of a building, showing general shape and design of exterior and roof (See Sheets #4 and #5 in Assignment Sheet Supplement #1)

E. Section — Cut-away vertical view through an object or wall to show its interior makeup (See Sheet #6 in Assignment Sheet Supplement #1)

(NOTE: A section view is limited to the specific portion of the building the architect wishes to clarify, and may be drawn on the same sheet as an elevation or plan or may appear on a separate sheet.)

F. Detail — Graphic, at a larger scale, of part of another drawing, indicating special features of design, location, and composition and the correlation of the elements and materials shown (See Sheets #7 through #10 in Assignment Sheet Supplement #1)

(NOTE: Detail drawings often use the cut-away section view to show aspects that are too small to be shown in sufficient detail on plan or elevation drawings. Like section drawings, detail drawings may be drawn on the same sheet as an elevation or plan drawing or may appear on a separate sheet in the set of plans.)

III. Information found on types of drawings in a set of plans

A. Plot plan

1. Location, dimensions, and elevation of structure on site
2. Finished and existing grade contours
3. Property lines and dimensions
4. Location of utilities
5. Location of existing conditions

   EXAMPLES: Trees, utility buildings, other structures

6. Location and dimensions of driveways and walks

B. Foundation plan

1. Location and dimensions of footings, grade beams, foundation walls, stem walls, piers, equipment footings, foundations
2. Location of anchor bolts (in detail view)

INFORMATION SHEET

C. Floor plan

   1. Outside walls, including location and dimensions of all exterior openings
   2. Types of construction materials
   3. Location of interior walls and partitions
   4. Location and swing of doors
   5. Stairways
   6. Location of windows
   7. Location of cabinets, electrical and mechanical equipment, fixtures
   8. Location of cutting-plane line

D. Elevation

   1. Grade lines
   2. Floor height
   3. Window and door types
   4. Roof lines and slope, roofing material, vents, gravel stops, projection of eaves
   5. Exterior finish materials and trim
   6. Exterior dimensions

E. Section

   1. Details of construction and information about stairs, walls, chimneys, or other parts of construction that may not show clearly on plan
   2. Floor levels in relation to grade
   3. Wall thickness at various locations
   4. Anchors and reinforcing steel

F. Detail

(NOTE: The following list itemizes types of information that may require a detail drawing. All of the items listed would never appear on a single detail drawing.)

   1. Footings and foundations, including anchor bolts, reinforcing, control joints
   2. Beams, floor joists, bridging, other support members
   3. Sills, floor framing, exterior walls, vapor barriers
   4. Floor heights, thickness, expansion, reinforcing

INFORMATION SHEET

5. Interior walls

6. Windows, exterior and interior doors, door frames

7. Roof, cornice, soffit, ceilings

8. Gravel stops, fascia, flashing

9. Fireplaces, chimneys

10. Staircases, stair assembly

11. Millwork, trim, ornamental iron, specialty items

IV. Uses of lines in the alphabet of lines

A. Object lines — Used to show main outline of structure, including exterior walls, interior partitions, porches, patios, sidewalks, parking lots, and driveways

(NOTE: Object lines are always the heaviest lines in the drawing.)

B. Dimension line — Used to designate object and area dimensions

(NOTE: Dimension lines may end in arrows, dots, or slashes. The dimension is usually written above the dimension line.)

C. Extension lines — Used as parameters for dimension lines

D. Hidden line — Used to show an object or area that is not visible from view depicted

E. Center line — Used to designate center and to provide a reference point for dimensioning

F. Cutting-plane line (section line) — Used to indicate an area that has been cut away and shown in a section view; arrows indicate direction from which section drawing is to be viewed

G. Phantom line — Used to indicate alternate positions of moving parts, adjacent positions of related parts, and for repeated details

H. Break line — Used to show that an object or area has not been drawn in its entirety

I. Leader line — Used to connect a note or dimension to a related part of the drawing

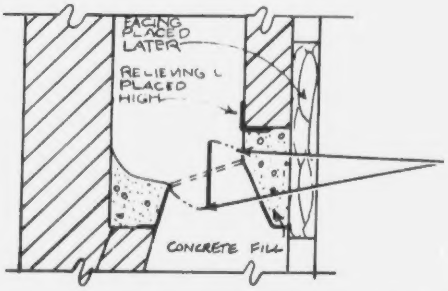
(NOTE: Leader lines are sometimes curved to avoid confusion with dimension lines and other lines.)

INFORMATION SHEET

V. Lines in the alphabet of lines (Figures 8 and 9)

A. Phantom line

FIGURE 8: Fireplace damper

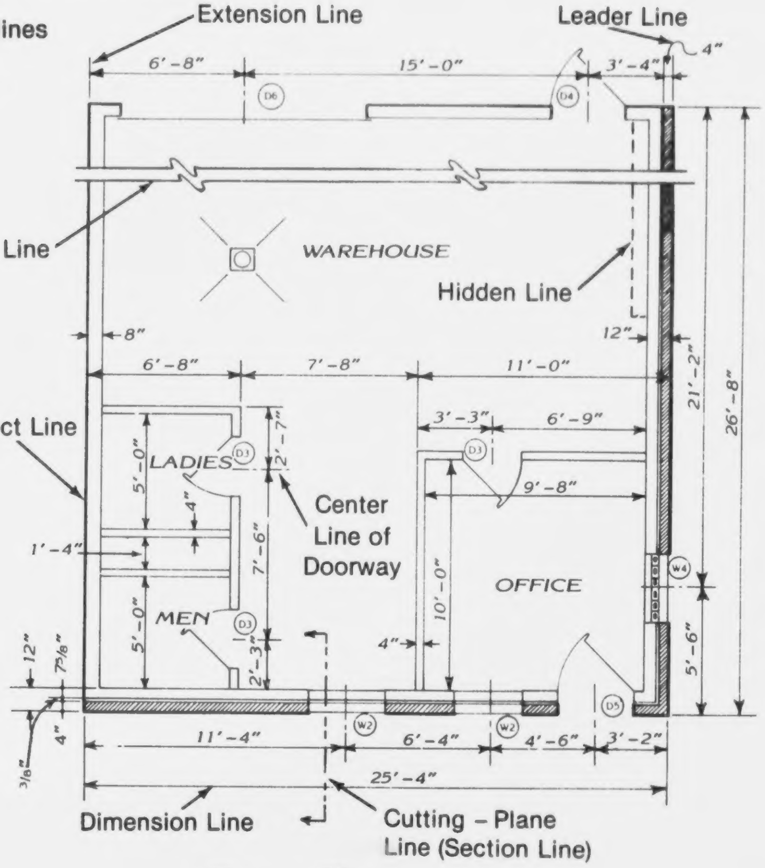

FACING PLACED LATER
RELIEVING L PLACED HIGH
CONCRETE FILL

Phantom Lines Showing Damper Swing

Reprinted by permission of John Wiley and Sons, Inc., New York, from *Architectural Graphic Standards*, 6th edition, by Charles G. Ramsey and Harold R. Sleeper, edited by Joseph N. Boaz, copyright © John Wiley and Sons, Inc., 1970.

B. Other lines

FIGURE 9


6'-8"
15'-0"
3'-4"
4"
D6
D4
WAREHOUSE
8"
12"
6'-8"
7'-8"
11'-0"
21'-2"
26'-8"
3'-3"
6'-9"
D3
LADIES
2'-7"
5'-0"
4"
9'-8"
1'-4"
7'-6"
5'-0"
MEN
D3
2'-3"
10'-0"
OFFICE
W4
5'-6"
4"
12"
7 5/8"
4"
3/8"
W2
W2
D5
11'-4"
6'-4"
4'-6"
3'-2"
25'-4"

Extension Line

Leader Line

Break Line

Hidden Line

Object Line

Center Line of Doorway

Dimension Line

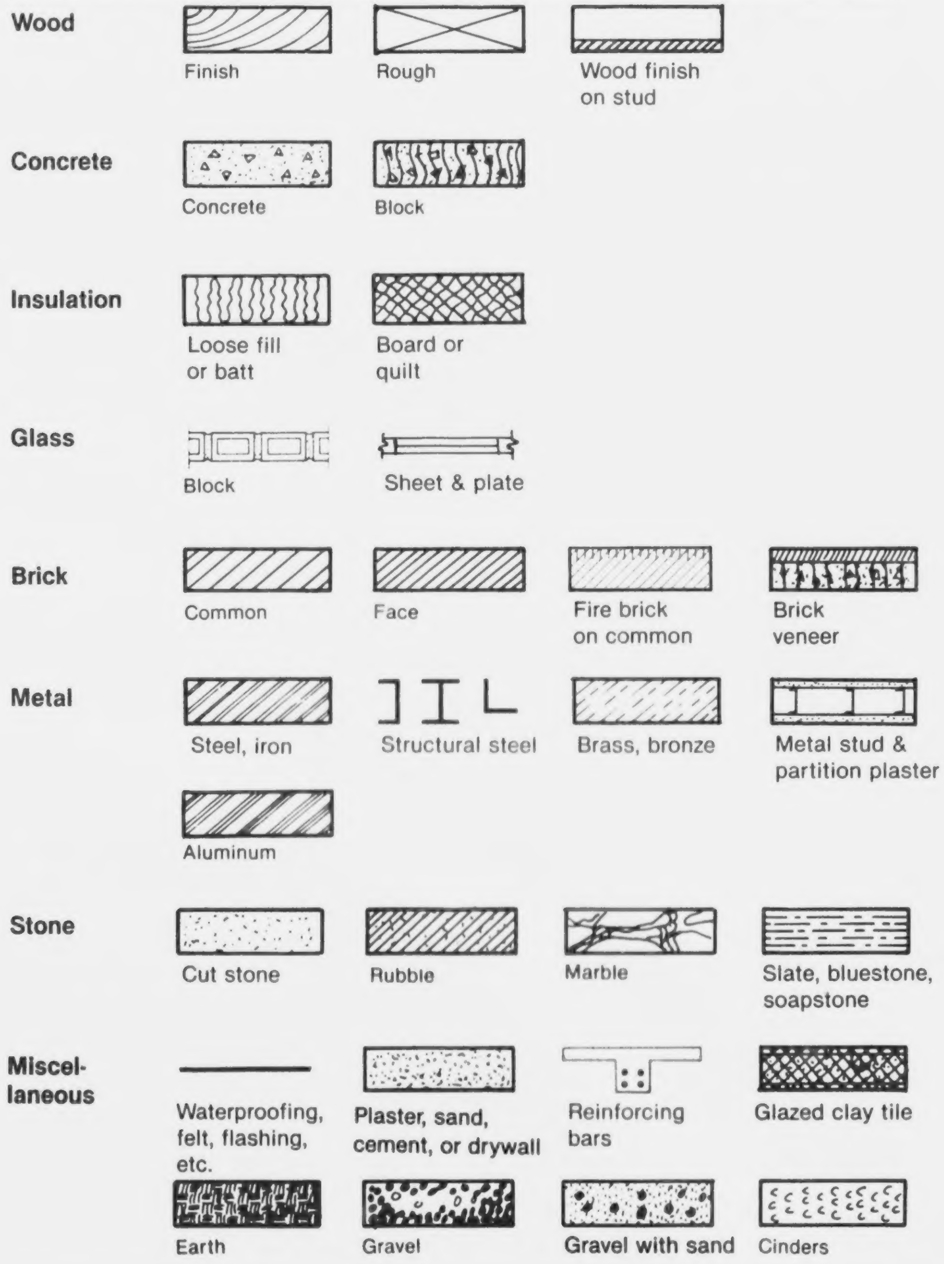
Cutting - Plane Line (Section Line)

INFORMATION SHEET

VI. Materials symbols commonly used on plans

A. General plan symbols (Table 1)

TABLE 1: General plan symbols

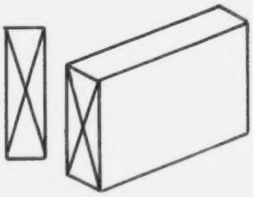

Wood
Finish
Rough
Wood finish on stud
Concrete
Concrete
Block
Insulation
Loose fill or batt
Board or quilt
Glass
Block
Sheet & plate
Brick
Common
Face
Fire brick on common
Brick veneer
Metal
Steel, iron
Structural steel
Brass, bronze
Metal stud & partition plaster
Aluminum
Stone
Cut stone
Rubble
Marble
Slate, bluestone, soapstone
Miscellaneous
Waterproofing, felt, flashing, etc.
Plaster, sand, cement, or drywall
Reinforcing bars
Glazed clay tile
Earth
Gravel
Gravel with sand
Cinders

INFORMATION SHEET

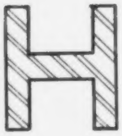
B. Section view symbols (Table 2)

TABLE 2: Section view symbols

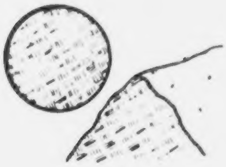
Rough lumber



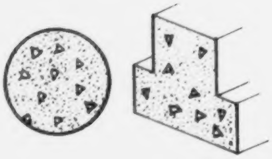
Metal



Earth



Concrete



VII. Abbreviations commonly used on plans

(NOTE: Many of the following abbreviations may also appear on written specifications; however, there is less standardization on specifications, and the abbreviations may contain periods and be written in lowercase letters.)

Anchor bolt	**AB**
Angle	∠
Architectural	**ARCH**
Bathroom	**B**
Bearing plate	**BRG PL**
Benchmark	**BM** or ⊕
Block	**BLK**
Brick	**BRK**
Building line	**BL**
Center	**CTR**
Center line	**CL** or **C L**
Center to center	**CC** or **C** to **C**
Column	**COL**
Concrete block	**CONC B**
Cutout	**CO**
Detail	**DET**
Dimension	**DIM**
Elevation	**ELEV**
Expansion joint	**EXP JT**
Finish floor	**FIN FL**
Finish grade	**FG**
Firebrick	**FBRK**
Fireplace	**FP**
Flashing	**FL**
Foundation	**FDN**
Full size or full scale	**FS**
Grade	**GR**
Grade line	**GL**
Inside diameter	**ID**
Joint	**JT**

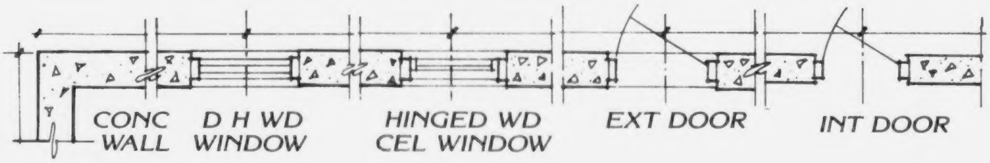
INFORMATION SHEET

Lineal	**LIN**
Masonry opening	**MO**
Material	**MATL**
Natural grade	**NG**
Nosing	**NOS**
Not to scale	**NTS**
On center	**OC**
Opening	**OPNG**
Overhead	**OVH**
Precast	**PRCST**
Radius	**R**
Recessed	**REC**
Reinforced	**REINF**
Required	**REQD**
Riser	**R**
Rough opening	**RO**
Scale	**SC**
Specifications	**SPEC**
Standard	**STD**
Steel	**ST** or **STL**
Stone	**ST**
Structural	**STR**
Terra cotta	**TC**
Typical	**TYP**
Waterproofing	**WP**
Weep hole	**WH**
Welded wire fabric	**WWF**

VIII. Representations of conventions used by architects

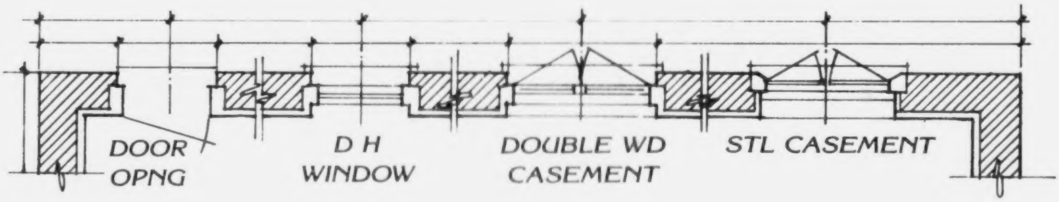
A. Doors and windows in concrete wall (Figure 10)

FIGURE 10


CONC WALL
D H WD WINDOW
HINGED WD CEL WINDOW
EXT DOOR
INT DOOR

B. Doors and windows in solid brick wall (Figure 11)

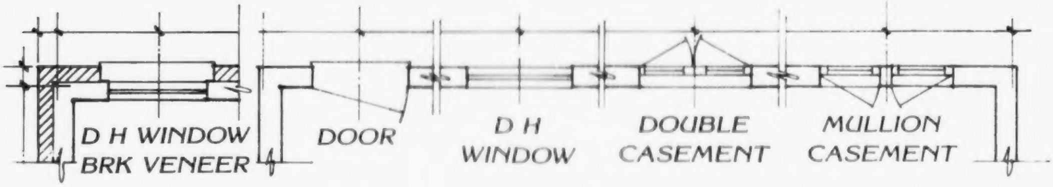
FIGURE 11


DOOR OPNG
D H WINDOW
DOUBLE WD CASEMENT
STL CASEMENT

INFORMATION SHEET

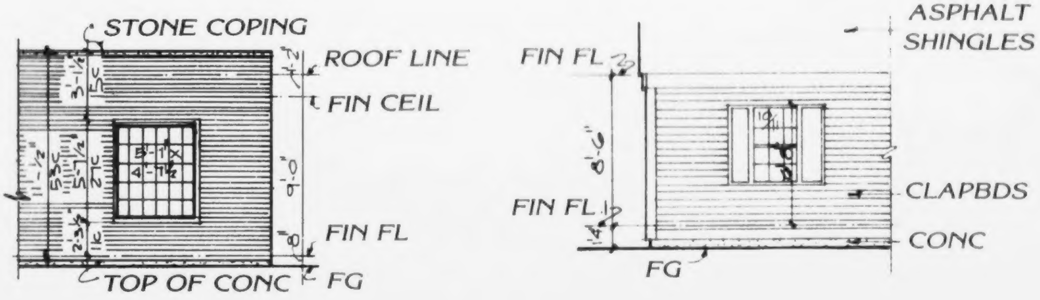
C. Doors and windows in brick veneer and wood stud walls (Figure 12)

FIGURE 12


D H WINDOW
BRK VENEER
DOOR
D H
WINDOW
DOUBLE
CASEMENT
MULLION
CASEMENT

D. Window elevations (Figure 13)

FIGURE 13

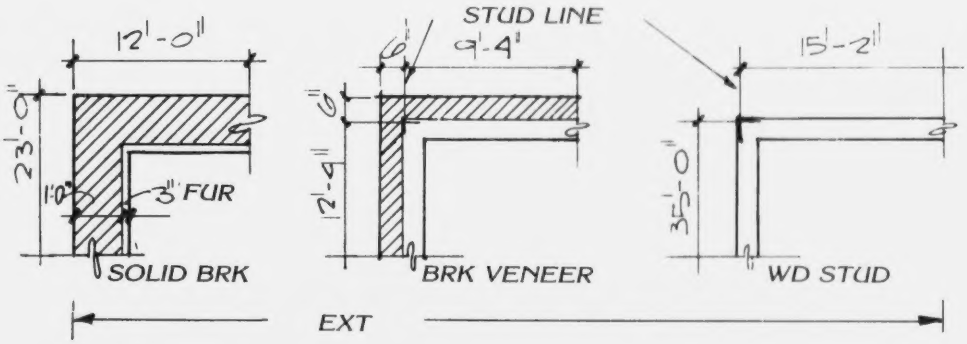

STONE COPING
ROOF LINE
FIN CEIL
FIN FL
TOP OF CONC
FG
4'-2"
3'-1½
5C
11'-1½"
53C
5'-7½
27C
5'-1" X
4'-1½
9'-0"
2'-3½
11C
8"
ASPHALT
SHINGLES
FIN FL
8'-6"
FIN FL
1'-4"
CLAPBDS
CONC
FG

BRK WALL

WD WALL

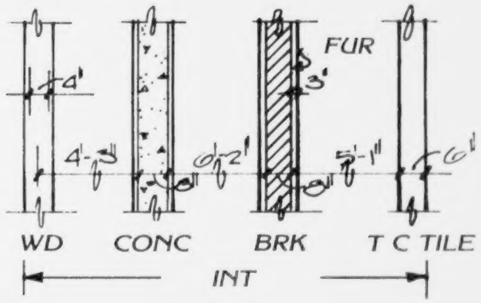
E. Dimensioning exterior and interior walls (Figures 14 and 15)

FIGURE 14


12'-0"
23'-0"
1'-0"
3" FUR
SOLID BRK
STUD LINE
6"
9'-4"
6"
12'-9"
BRK VENEER
15'-2"
35'-0"
WD STUD
EXT

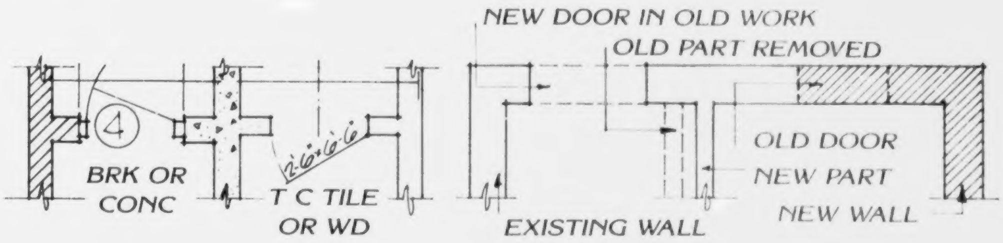
INFORMATION SHEET

FIGURE 15


FUR
4'
3'
4'-3"
6'-2"
5'-1"
6'
WD
CONC
BRK
T C TILE
INT

F. Interior dimensions and alterations (Figure 16)

FIGURE 16


NEW DOOR IN OLD WORK
OLD PART REMOVED
④
BRK OR CONC
2'6"×6'6"
T C TILE OR WD
OLD DOOR
NEW PART
NEW WALL
EXISTING WALL

IX. Purposes of written specifications

(NOTE: Written specifications are equally as important as the drawings in a set of plans. They furnish what the drawings cannot, in that they give detailed and accurate written descriptions of work to be done, including quality and quantity of materials, methods of construction, standards of construction, and manner of conducting the work. See Assignment Sheet Supplement #2 at the end of the information sheet for materials specifications.)

A. Avoiding disputes among builders, architects, and owners by leaving no room for misinterpretation or misunderstanding

B. Facilitating the checking of materials and workmanship during time that building is being constructed

C. Enabling contractors to make bids based on total materials and labor required

D. Avoiding expensive omissions when estimating total costs

E. Avoiding conflicting opinions during construction and avoiding the added costs and delays that could result

INFORMATION SHEET

X. Basic information included in a set of written specifications pertaining to concrete

   A. Type and quality of material

      EXAMPLES: Type and strength of concrete; type of reinforcing steel

   B. Sizes

   C. Method of construction

   D. Slump of concrete

   E. Concrete test

   F. Concrete finishes

   G. Tolerances

XI. Reading an architect's scale

   A. Determine scale to be used

      (NOTE: The scale used will be that to which the plan is drawn or one you have chosen if you are making a drawing.)

   B. Locate the required scale on the architect's scale

      EXAMPLES: 3/16", 1/4", 1"

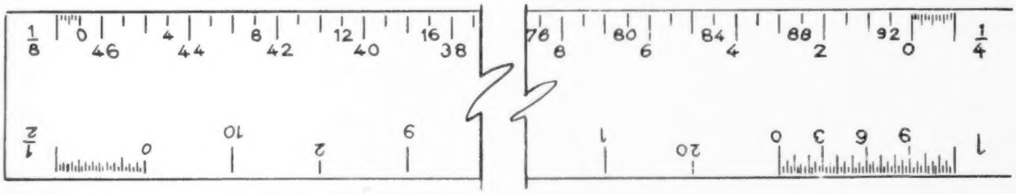
      (NOTE: The whole or fractional number shown at the ends of an architect's scale shows the scales marked for that side. Thus, 3/16 designates a scale of 3/16" = 1' -0". The marks for a 3/16-inch scale are 3/16 of an inch apart, with each mark representing 1 foot of distance on the drawing.)

   C. Determine direction in which required scale is read

      (NOTE: Each scale is numbered, beginning near the number that designates the scale used, and is read toward the opposite end. For example, in Figure 17, the 1/8-inch scale begins at the left end and is read to the right. The 1/4-inch scale begins at the right end and is read to the left.)

      EXAMPLE:

FIGURE 17



INFORMATION SHEET

D. Locate the zero mark for the required scale

(NOTE: The distance between the zero mark and the scale designation is subdivided to show inches or fractions of inches at that scale. Foot designations are aligned with the zero mark.)

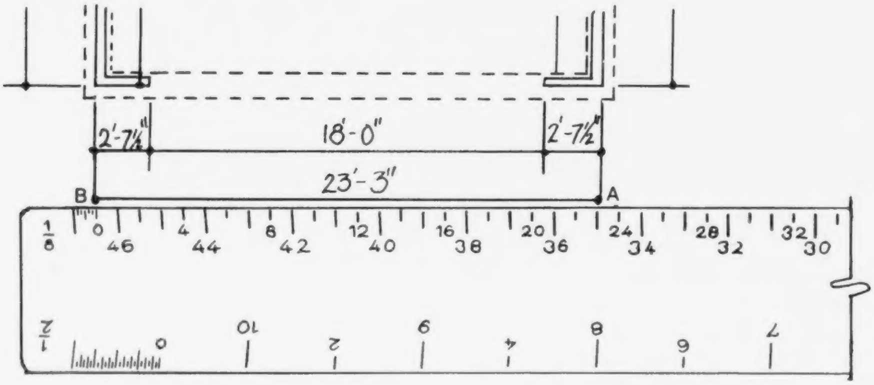
E. Measure the distance on the plan

EXAMPLE: Measure the width of the garage in Figure 18, using a scale of $^1/_8" = 1'-0"$.

1. Align the largest possible foot mark with one reference point, with other reference point falling within the scale's inch subdivisions (Figure 18)

   EXAMPLE:

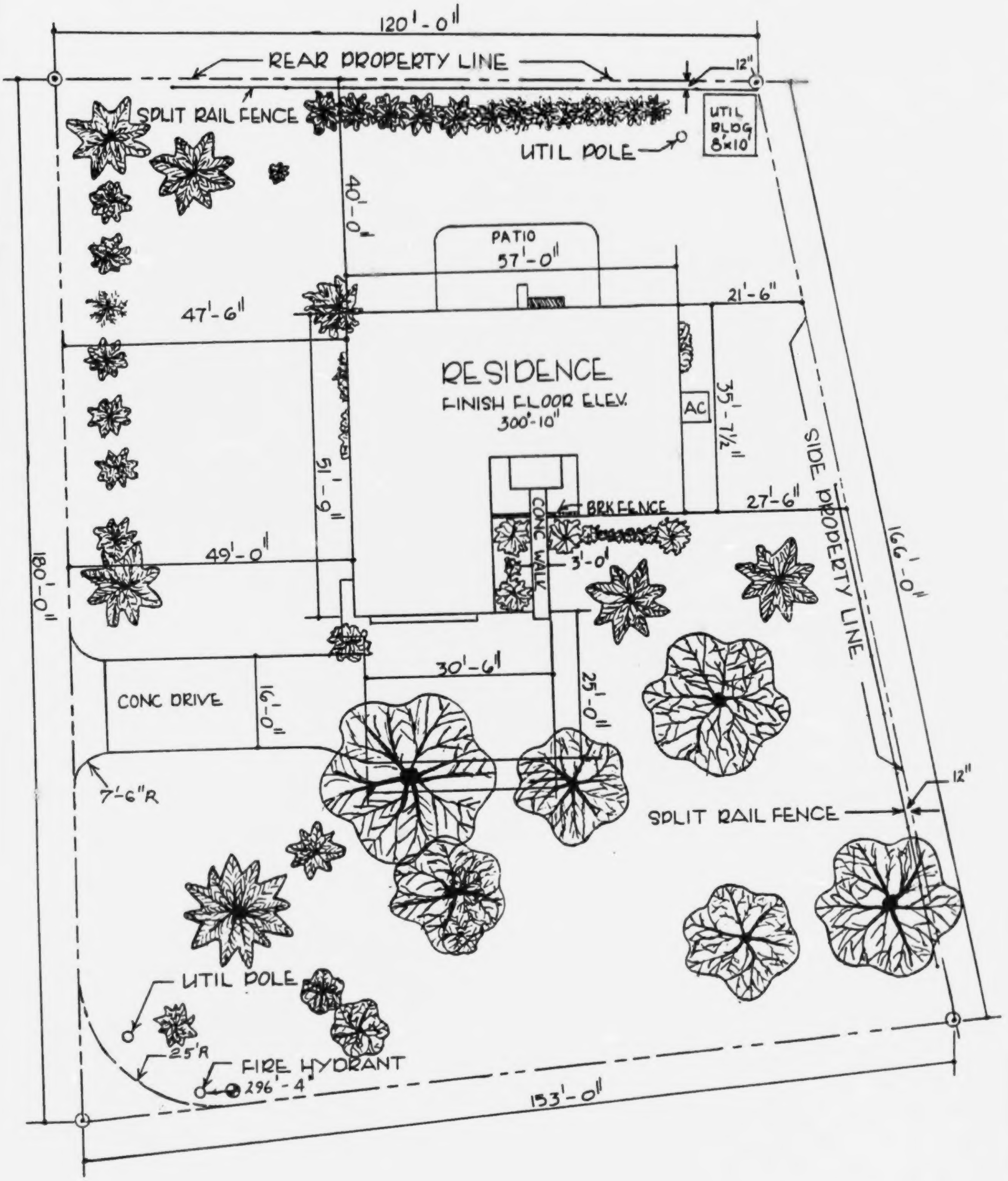
FIGURE 18



2. Note the value of the foot mark

3. Add to the foot value the value of the inch subdivisions

   EXAMPLE: The distance measured in Figure 18 is 23'-3" because the distance from the zero mark to Point A is 23 feet, and the distance from the zero mark to Point B is 3 inches.

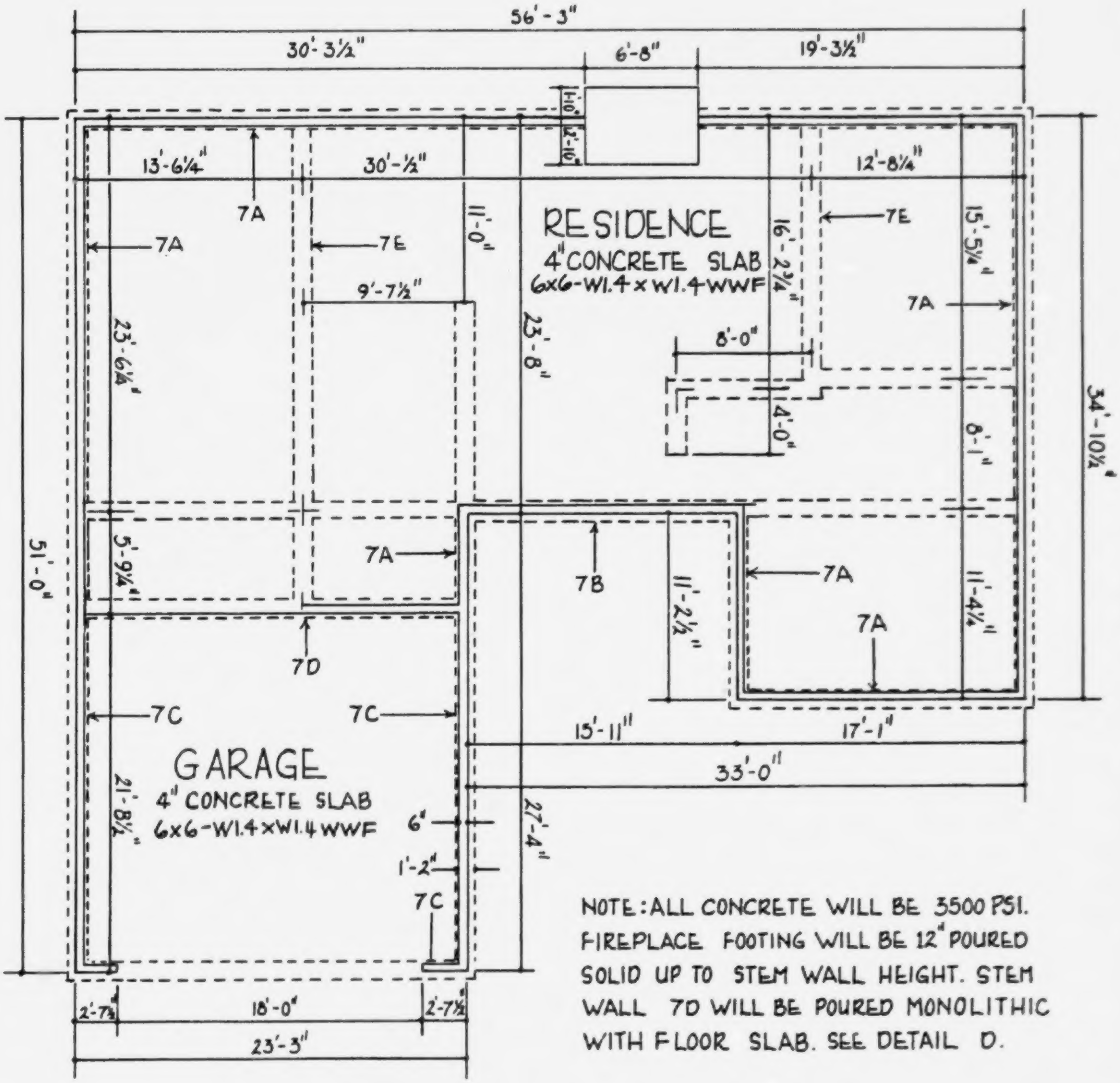

120'-0"
REAR PROPERTY LINE
12"
SPLIT RAIL FENCE
UTIL BLDG 8'x10'
UTIL POLE
40'-0"
PATIO
57'-0"
21'-6"
47'-6"
RESIDENCE
FINISH FLOOR ELEV.
300'-10"
AC
35'-7½"
SIDE PROPERTY LINE
51'-9"
BRK FENCE
27'-6"
CONC WALK
3'-0"
166'-0"
180'-0"
49'-0"
30'-6"
25'-0"
CONC DRIVE
16'-0"
7'-6"R
12"
SPLIT RAIL FENCE
UTIL POLE
25'R
FIRE HYDRANT
296'-4"
153'-0"

PLOT PLAN

SCALE:- 1" = 20'-0" N

ASSIGNMENT SHEET SUPPLEMENT #1

FOCM - 267-B



56'-3"
30'-3½"
6'-8"
19'-3½"
1'-10"
2'-10"
13'-6¼"
30'-½"
12'-8¼"
7A
7A
7E
7E
11'-0"
RESIDENCE
4" CONCRETE SLAB
6x6-W1.4xW1.4WWF
16'-2¾"
15'-5¼"
9'-7½"
7A
23'-6¼"
23'-8"
8'-0"
34'-10½"
4'-0"
8'-1"
51'-0"
5'-9¼"
7A
7B
11'-2½"
7A
11'-4¼"
7A
7D
7C
7C
15'-11"
17'-1"
33'-0"
GARAGE
4" CONCRETE SLAB
6x6-W1.4xW1.4WWF
21'-8½"
6"
27'-4"
1'-2"
7C
2'-7½
18'-0"
2'-7½
23'-3"

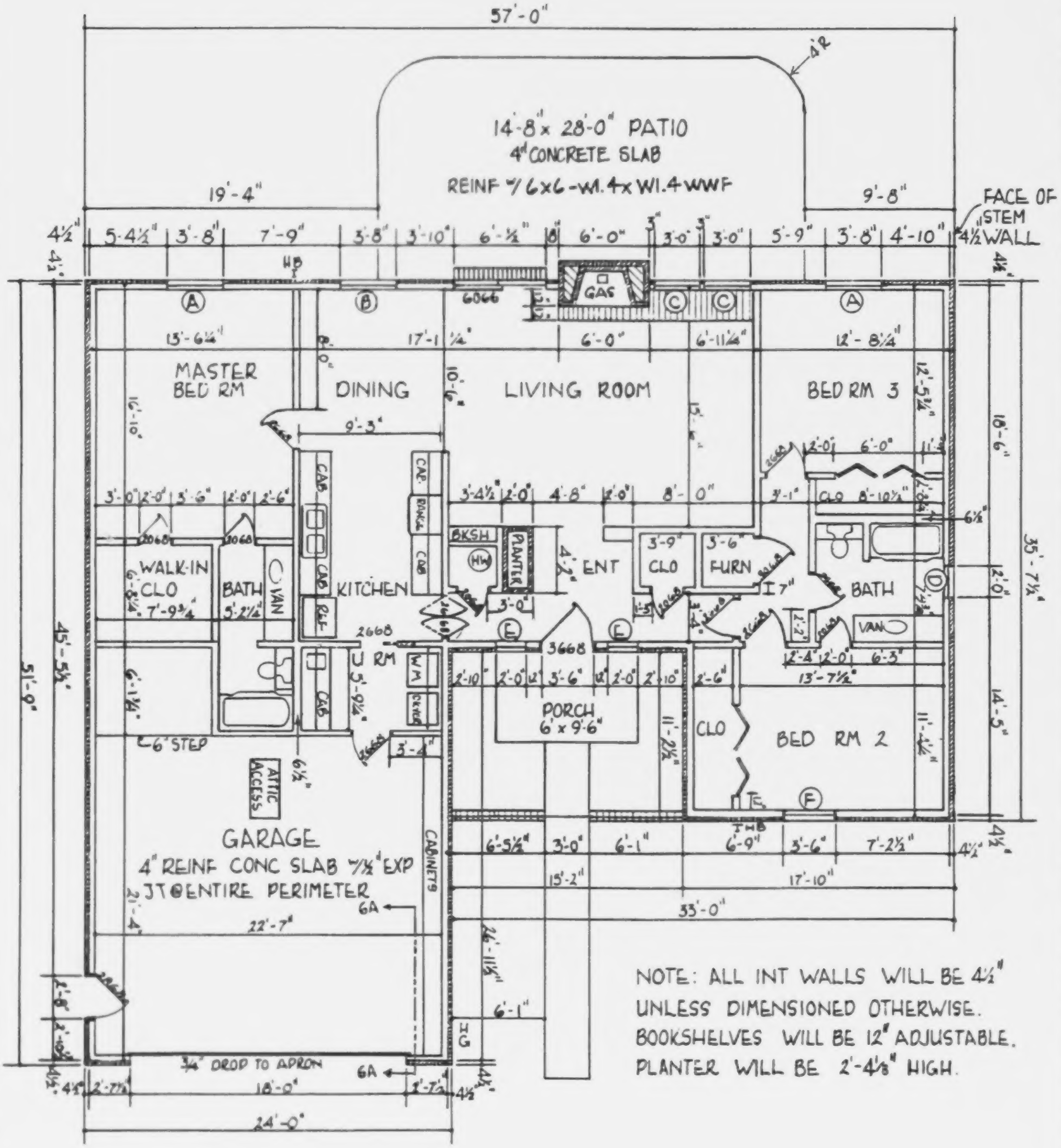
NOTE: ALL CONCRETE WILL BE 3500 PSI. FIREPLACE FOOTING WILL BE 12" POURED SOLID UP TO STEM WALL HEIGHT. STEM WALL 7D WILL BE POURED MONOLITHIC WITH FLOOR SLAB. SEE DETAIL D.

FOUNDATION PLAN

SCALE :- ⅛" = 1'-0"　N

ASSIGNMENT SHEET SUPPLEMENT #1

FCCM - 269-B


57'-0"
4'R
14'-8" x 28'-0" PATIO
4" CONCRETE SLAB
REINF w/ 6x6-W1.4xW1.4 WWF
19'-4"
9'-8"
FACE OF STEM WALL
4½"
5'-4½"
3'-8"
7'-9"
3'-8"
3'-10"
6'-½"
6'-0"
3'-0"
3'-0"
5'-9"
3'-8"
4'-10"
HB
6066
GAS
A
B
C
D
E
F
G
13'-6¼"
17'-1 ¼"
6'-0"
6'-11¼"
12'-8¼"
MASTER BED RM
DINING
LIVING ROOM
BED RM 3
16'-10"
10'-6"
12'-5¼"
9'-3"
CAB
BKSH
PLANTER
HW
ENT
CLO
FURN
WALK-IN CLO
7'-9¾"
BATH
5'-2½"
VAN
KITCHEN
REF
2068
2668
3668
U RM
W
D
5'-9½"
6'-1½"
6' STEP
ATTIC ACCESS
3'-4"
PORCH
6' x 9'-6"
CLO
BED RM 2
13'-7½"
11'-4"
11'-2½"
GARAGE
4" REINF CONC SLAB w/ ½" EXP JT @ ENTIRE PERIMETER
22'-7"
21'-4"
CABINETS
6A
¾" DROP TO APRON
18'-0"
2'-7½"
24'-0"
6'-1"
26'-11½"
45'-5½"
51'-0"
18'-6"
35'-7½"
14'-5"
12'-0"
6'-5½"
3'-0"
6'-1"
6'-9"
3'-6"
7'-2½"
15'-2"
17'-10"
33'-0"
THB

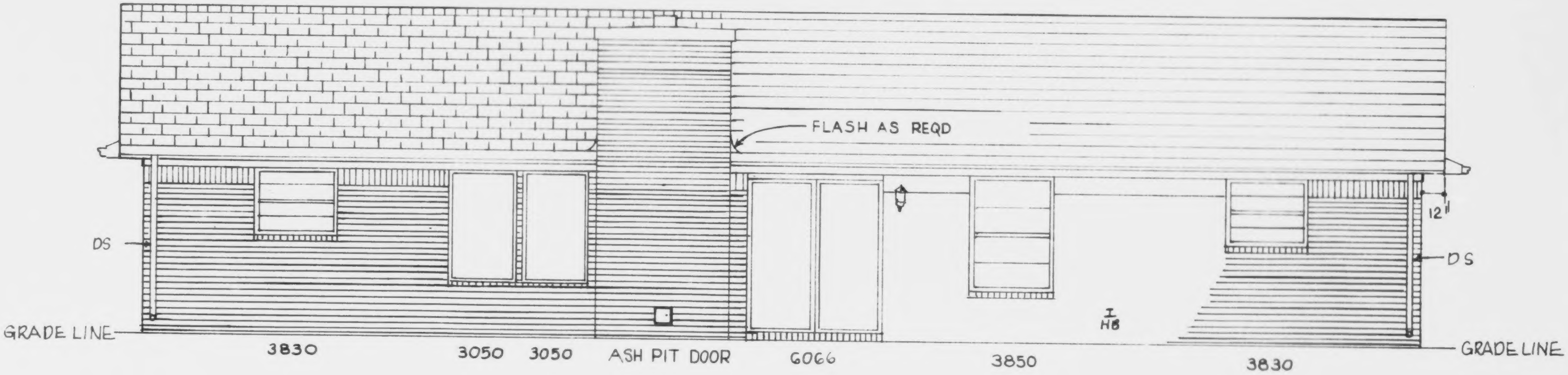
NOTE: ALL INT WALLS WILL BE 4½" UNLESS DIMENSIONED OTHERWISE.
BOOKSHELVES WILL BE 12" ADJUSTABLE.
PLANTER WILL BE 2'-4⅛" HIGH.

FLOOR PLAN

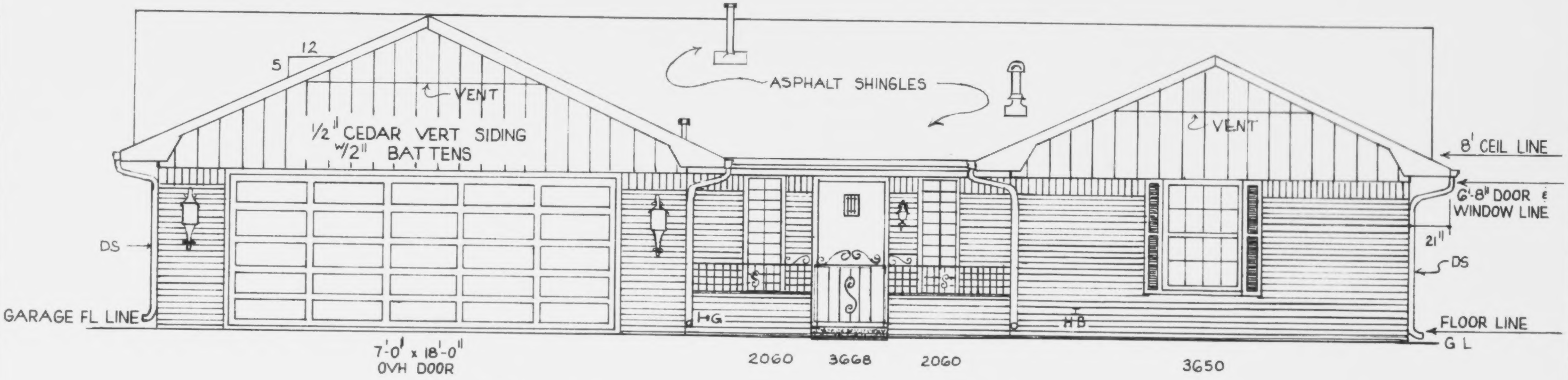
SCALE :- ⅛" = 1'-0"

N

SHEET 3


FLASH AS REQD
DS
12"
DS
GRADE LINE
GRADE LINE
HB
3830
3050
3050
ASH PIT DOOR
6066
3850
3830

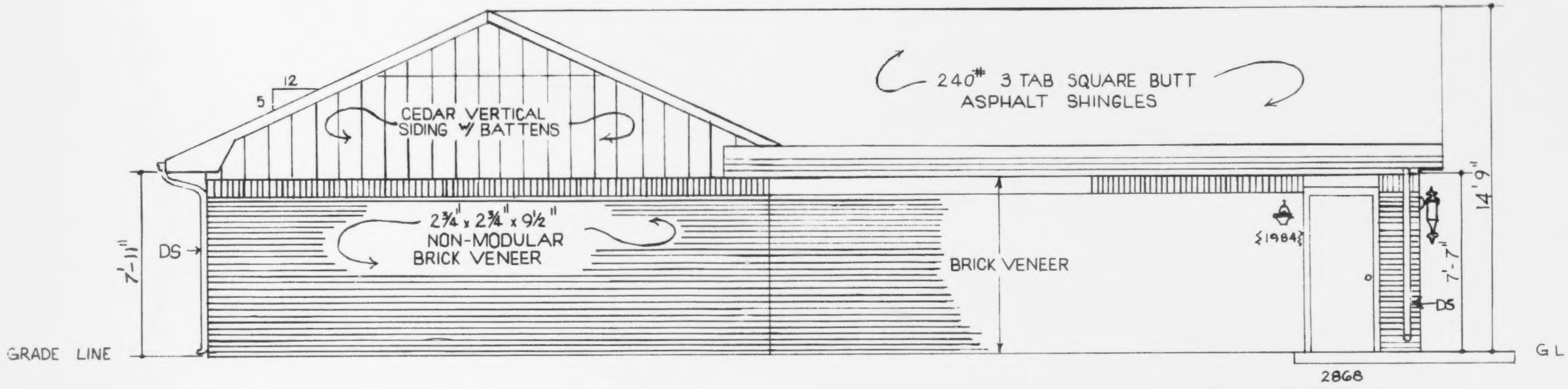
EAST ELEVATION


12
5
VENT
ASPHALT SHINGLES
½" CEDAR VERT SIDING
w/½" BATTENS
VENT
8' CEIL LINE
6'-8" DOOR & WINDOW LINE
21"
DS
DS
GARAGE FL LINE
HG
HB
FLOOR LINE
G L
7'-0" x 18'-0"
OVH DOOR
2060
3668
2060
3650

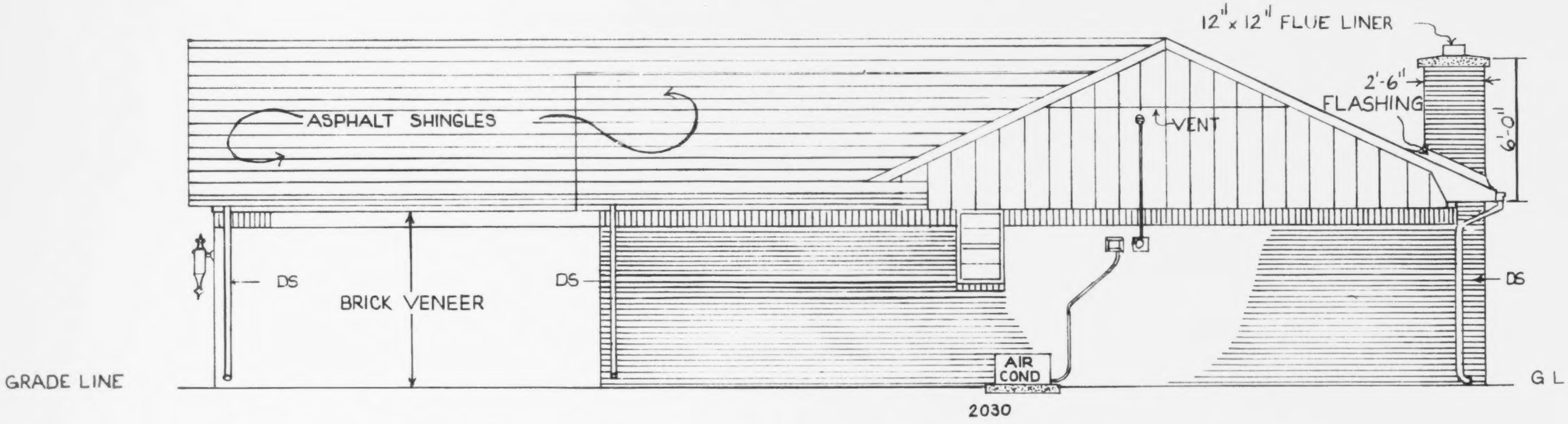
ELEVATION PLAN

WEST ELEVATION

SCALE :-3/16"=1'-0" N


12
5
CEDAR VERTICAL SIDING W/ BATTENS
240# 3 TAB SQUARE BUTT ASPHALT SHINGLES
2¾" x 2¾" x 9½" NON-MODULAR BRICK VENEER
BRICK VENEER
DS
7'-11"
GRADE LINE
{1984}
14'9"
7'-7"
DS
GL
2868

NORTH ELEVATION

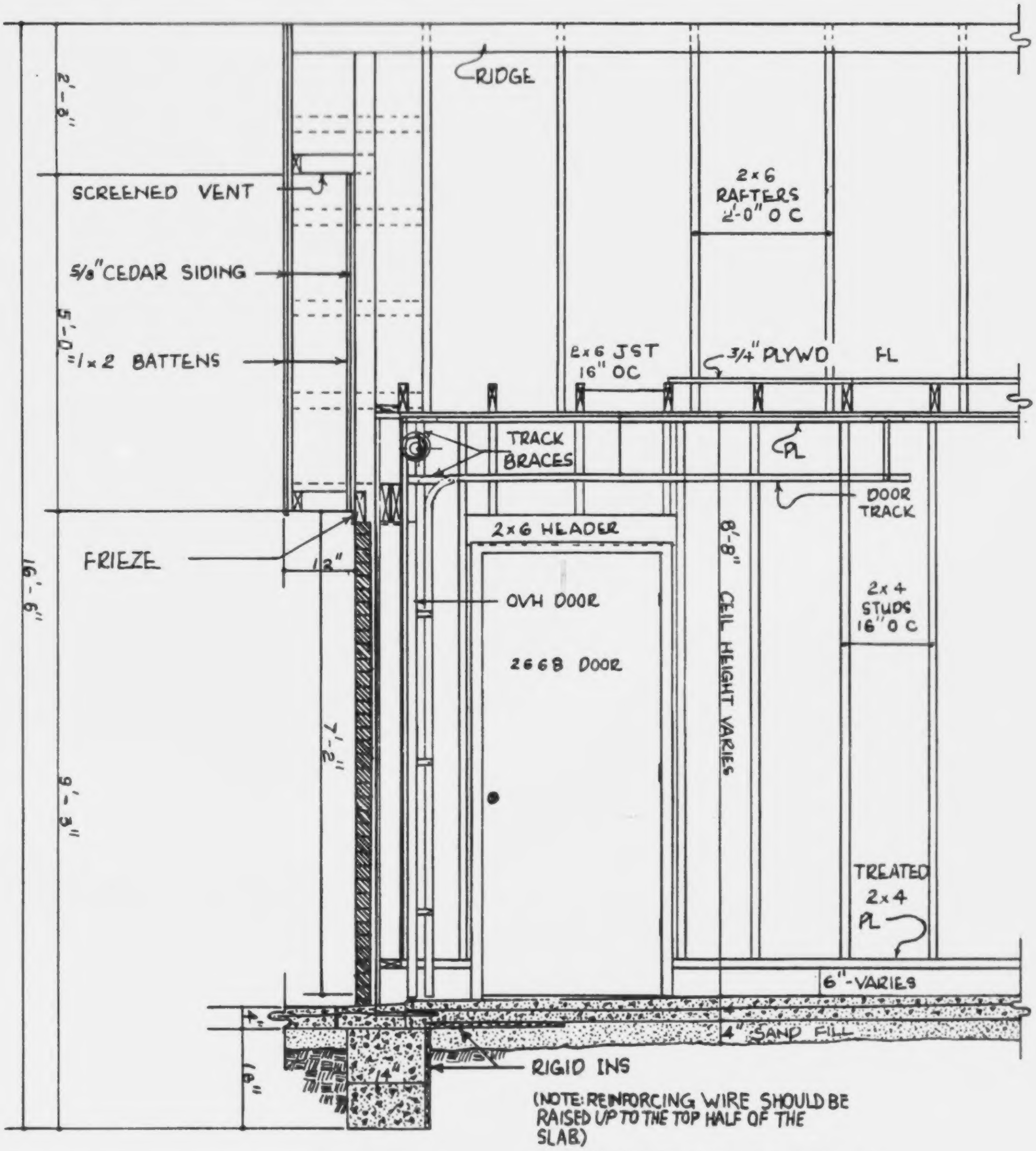

12" x 12" FLUE LINER
2'-6"
FLASHING
6'-0"
ASPHALT SHINGLES
VENT
DS
BRICK VENEER
DS
DS
AIR COND
GRADE LINE
GL
2030

ELEVATION PLAN

SOUTH ELEVATION

CONTINUED

SCALE :- 3/16" = 1'-0"


RIDGE
SCREENED VENT
5/8" CEDAR SIDING
1x2 BATTENS
2x6 RAFTERS 2'-0" O C
2x6 JST 16" OC
3/4" PLYWD
FL
TRACK BRACES
PL
DOOR TRACK
2x6 HEADER
FRIEZE
12"
OVH DOOR
2668 DOOR
8'-8" CEIL HEIGHT VARIES
2x4 STUDS 16" O C
TREATED 2x4 PL
6"-VARIES
4" SAND FILL
RIGID INS
2'-8"
5'-0"
16'-6"
9'-3"
7'-2"
4"
16"
14"

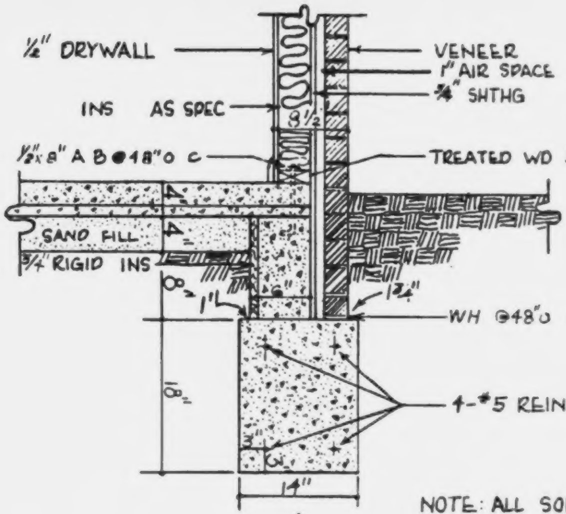
(NOTE: REINFORCING WIRE SHOULD BE RAISED UP TO THE TOP HALF OF THE SLAB)

FLOOR SLOPED 2" FROM INSIDE WALL OUT.

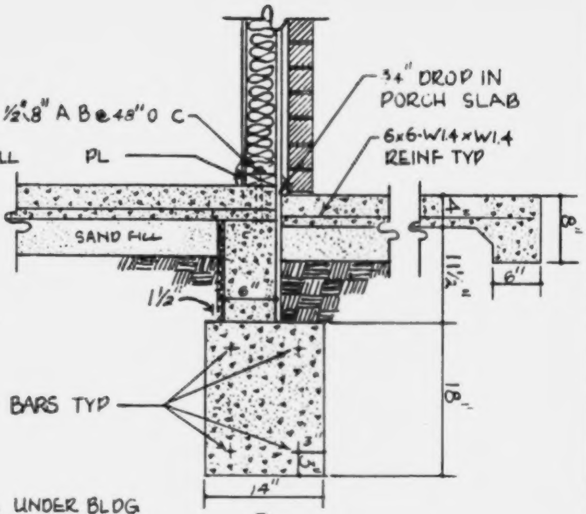
SECTION AA

SECTION DRAWING

SCALE :- 1/2" = 1'-0"

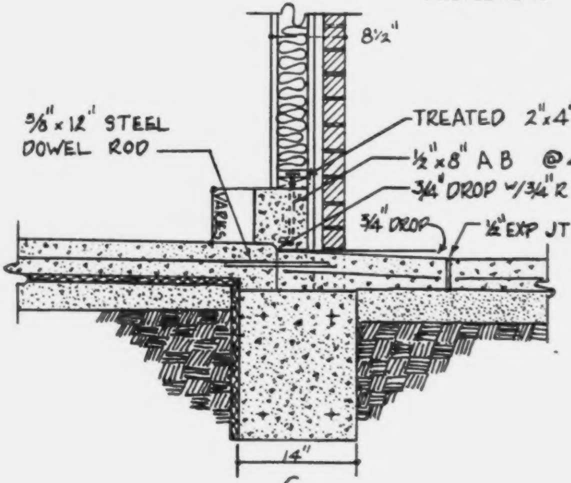

1/2" DRYWALL
INS AS SPEC
1/2"x8" A B @48" O C
VENEER
1" AIR SPACE
3/4" SHTHG
8 1/2
TREATED WD SILL
SAND FILL
3/4" RIGID INS
1"
1 3/4"
6"
WH @48" O C
18"
3"
3
14"

A

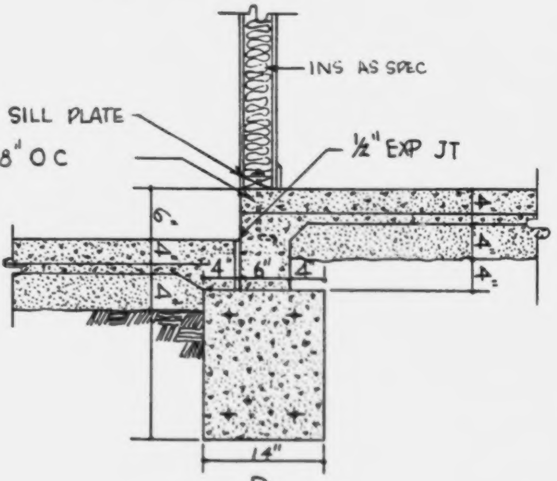

3/4" DROP IN PORCH SLAB
1/2"x8" A B @48" O C
PL
6x6-W1.4xW1.4 REINF TYP
SAND FILL
8"
11 1/2"
6"
1 1/2
6"
4-#5 REINF BARS TYP
18"
3
3
14"

B

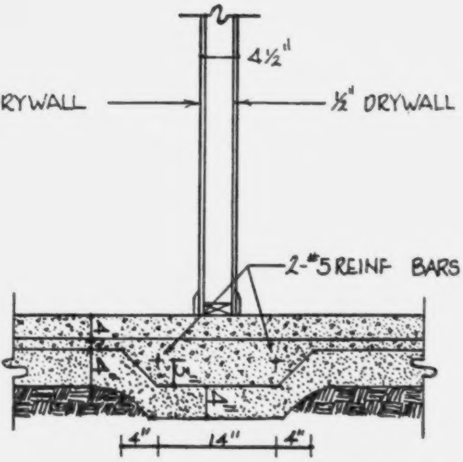
NOTE: ALL SOIL UNDER BLDG
TO BE TREATED FOR TERMITE
PROTECTION.


8 1/2"
5/8"x12" STEEL DOWEL ROD
VARIES
TREATED 2"x4" SILL PLATE
1/2"x8" A B @48" O C
3/4" DROP w/3/4" R
3/4" DROP
1/2" EXP JT
14"

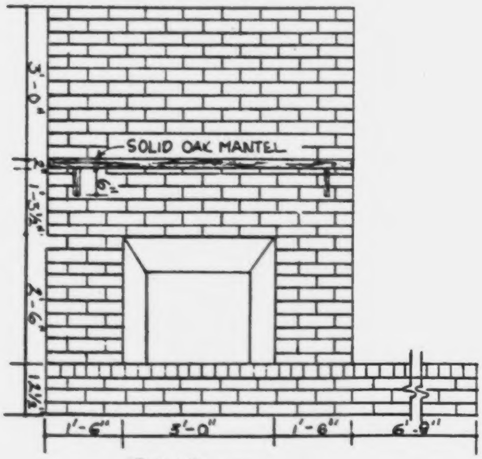
C


INS AS SPEC
1/2" EXP JT
6"
4"
4"
6"
4"
4"
4"
4"
4"
14"

D


4 1/2"
1/2" DRYWALL
1/2" DRYWALL
2-#5 REINF BARS
4"
14"
4"

E FOUNDATIONS

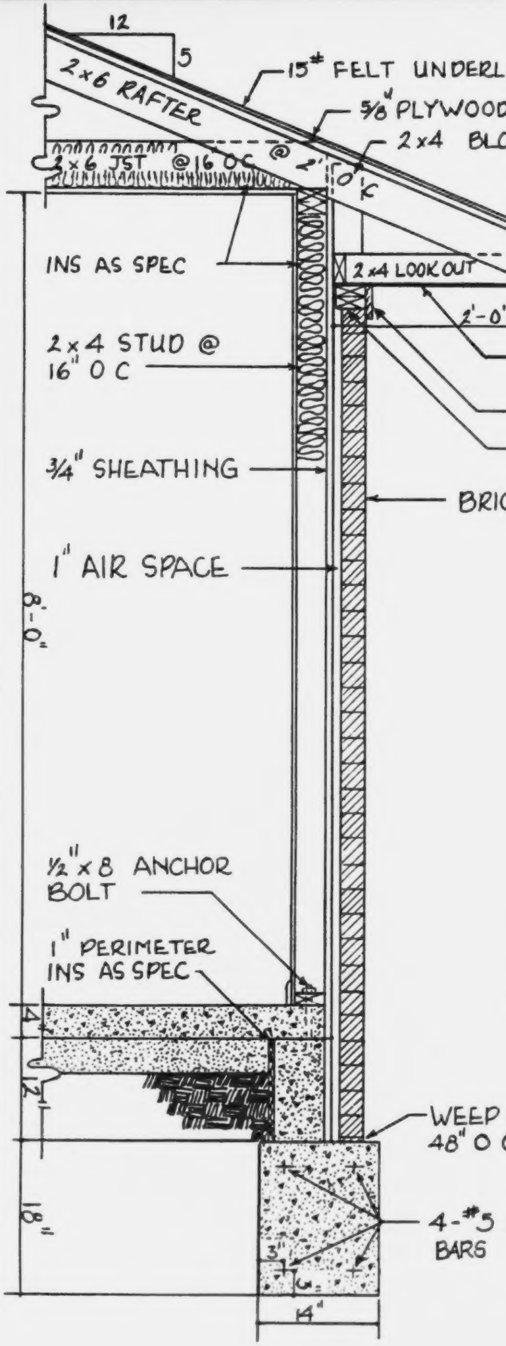

3'-0"
SOLID OAK MANTEL
2
6"
1'-5 1/2"
2'-6"
1'-2 1/2"
1'-6"
3'-0"
1'-6"
6'-9"

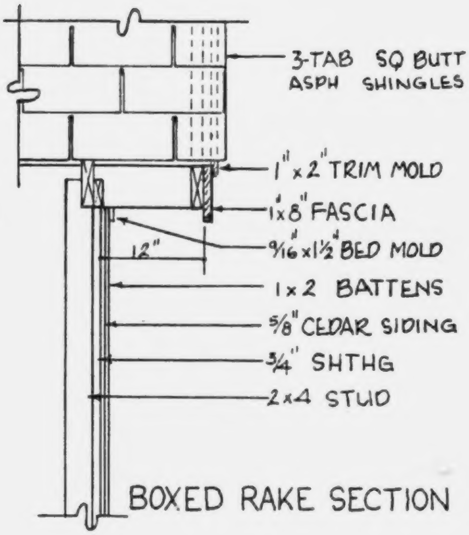
FIREPLACE

SCALE :- 3/4" = 1'-0"

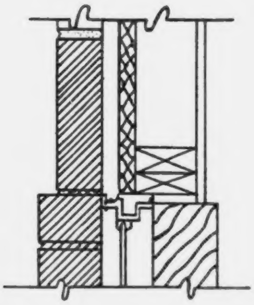
SCALE :- 3/8" = 1'-0"

DETAILS

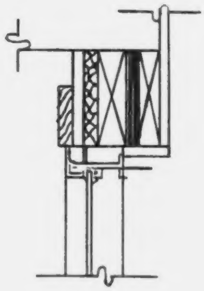

12
5
15# FELT UNDERLAYMENT
2x6 RAFTER
5/8" PLYWOOD SHTHG
2x4 BLOCKING
2x6 JST @16" OC
@ 2' 0" C
1"x2" TRIM
2x4 LOOKOUT
INS AS SPEC
2'-0"
1"x8" FASCIA
2x4 STUD @ 16" O C
1/4" EXT PLYWOOD SOFFIT
1"x4" FRIEZE
2 x 4 BLKG
3/4" SHEATHING
BRICK VENEER
1" AIR SPACE
8'-0"
1/2"x8 ANCHOR BOLT
1" PERIMETER INS AS SPEC
4"
12"
WEEP HOLE @ 48" O C
8"
4-#5 REINF BARS
3"
6"
14"


3-TAB SQ BUTT ASPH SHINGLES
1"x2" TRIM MOLD
1"x8" FASCIA
12"
9/16"x1 1/2" BED MOLD
1x2 BATTENS
5/8" CEDAR SIDING
3/4" SHTHG
2x4 STUD

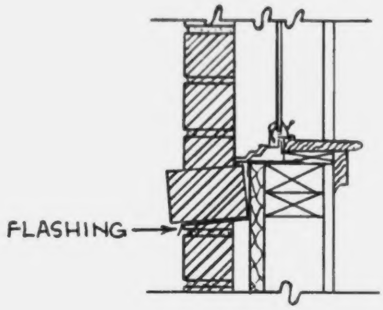
BOXED RAKE SECTION



JAMB



HEAD



SILL

CORNICE CONST

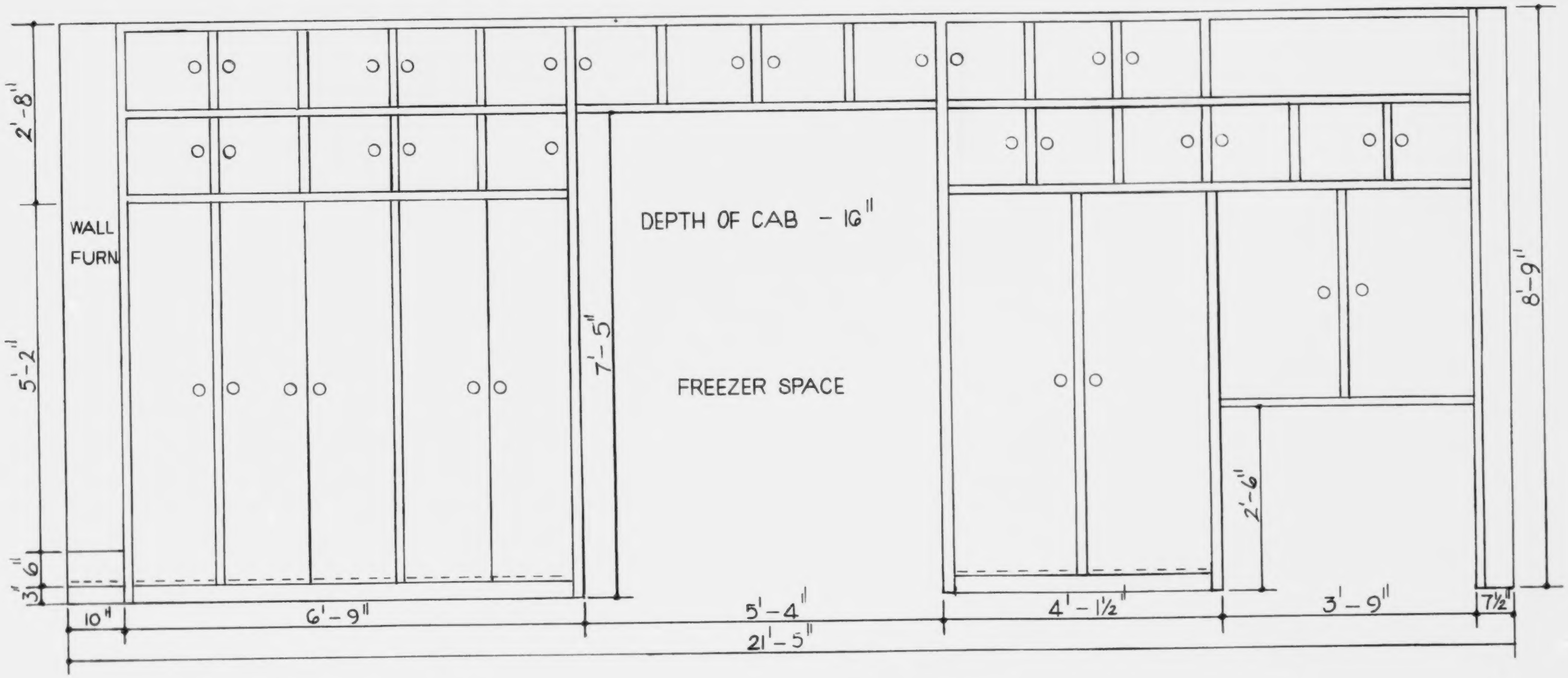
SCALE :- 3/4" = 1'-0"

SCALE :- 1 1/2" = 1'-0"

DETAILS

ASSIGNMENT SHEET SUPPLEMENT #1

SHEET 10

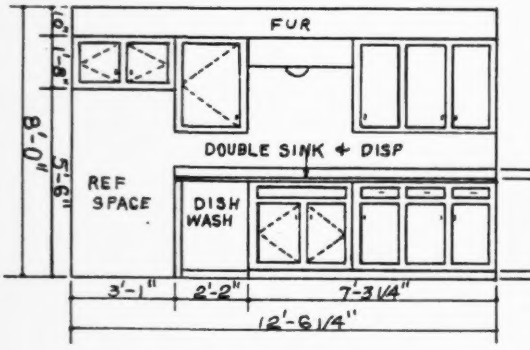

2'-8"
5'-2"
6"
3"
WALL
FURN.
DEPTH OF CAB - 16"
FREEZER SPACE
7'-5"
2'-6"
8'-9"
10"
6'-9"
5'-4"
4'-1½"
3'-9"
7½"
21'-5"

GARAGE CABINETS

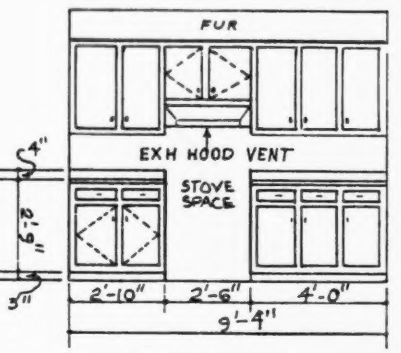
DETAILS

SCALE :- ½" = 1'-0"

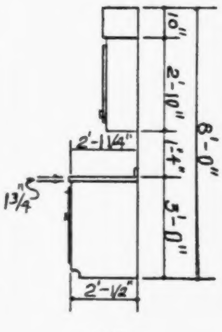
KITCHEN CABINETS


FUR
DOUBLE SINK + DISP
REF SPACE
DISH WASH
6"
1'-8"
8'-0"
5'-6"
4"
2'-9"
3"
3'-1"
2'-2"
7'-3 1/4"
12'-6 1/4"

NORTH WALL


FUR
EXH HOOD VENT
STOVE SPACE
2'-10"
2'-6"
4'-0"
9'-4"

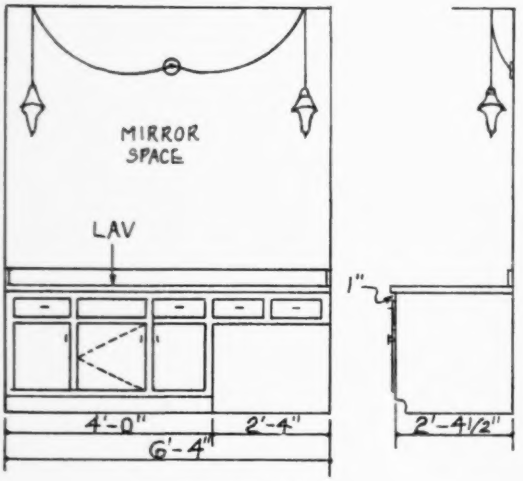
SOUTH WALL


10"
2'-10"
8'-0"
2'-1 1/4"
1'-4"
3'-0"
1 3/4"
2'-1/2"

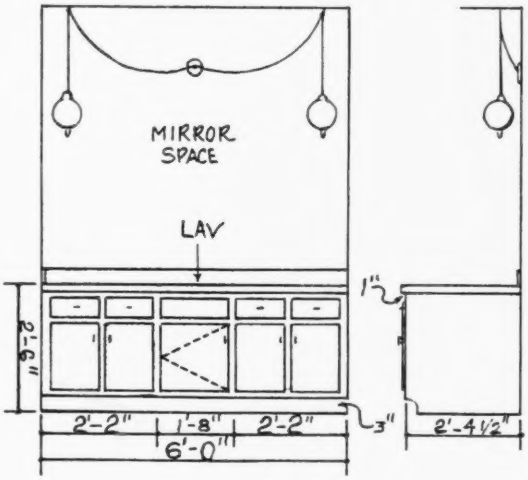
END VIEW

SCALE:-1/4"=1'-0"

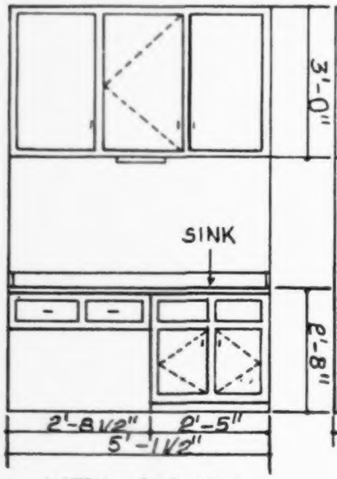
BATHROOMS


MIRROR SPACE
LAV
1"
4'-0"
2'-4"
6'-4"
2'-4 1/2"

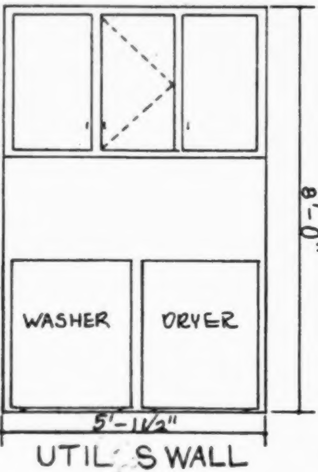
VANITY #1


MIRROR SPACE
LAV
1"
2'-6"
2'-2"
1'-8"
2'-2"
6'-0"
3"
2'-4 1/2"

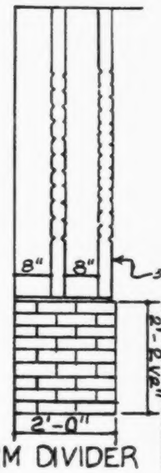
VANITY #2


SINK
3'-0"
2'-8"
2'-8 1/2"
2'-5"
5'-1 1/2"

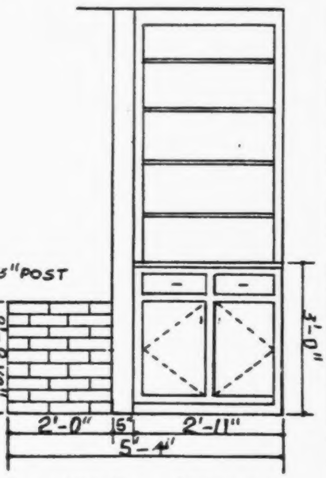
UTIL N WALL


WASHER
DRYER
8'-0"
5'-1 1/2"

UTIL S WALL


8"
8"
3"POST
2'-2 1/2"
2'-0"

RM DIVIDER


3'-0"
2'-0"
5"
2'-11"
5'-4"

PLANTER + BOOKCASE

DETAILS

SCALE:-3/8"=1'-0"

ASSIGNMENT SHEET SUPPLEMENT #1

FCCM - 281-B

ROOMS	FLOOR					CEILING					WALL				BASE				TRIM				REMARKS
	CARPET	CERAMIC TILE	RUBBER TILE	CONCRETE		ACOUSTIC TEXT	DRYWALL	PAINT	CERAMIC TILE		DRYWALL	PAINT	WALL PAPER	CERAMIC TILE	WOOD	RUBBER	CERAMIC TILE	STAIN		WOOD	STAIN	PAINT	
ENTRY		✓				✓					✓	✓	✓		✓			✓		✓	✓		See owner for all painting
HALL	✓					✓					✓	✓			✓			✓		✓	✓		
BEDROOM 1	✓					✓					✓	✓	✓		✓			✓		✓	✓		See owner for grade of carpet
BEDROOM 2	✓					✓					✓	✓			✓			✓		✓	✓		See owner for grade of carpet
BEDROOM 3	✓					✓					✓	✓			✓			✓		✓	✓		See owner for grade of carpet
BATH 1	✓	✓				✓			✓		✓	✓	✓	✓	✓			✓		✓	✓		Wallpaper three walls around vanity
BATH 2		✓				✓			✓		✓	✓	✓	✓			✓			✓	✓		Water-seal tile wallpaper w. wall
UTIL. + CLOSETS	✓		✓ ✓				✓	✓			✓ ✓	✓			✓			✓		✓ ✓	✓	✓	Use off-white flat/latex
KITCHEN			✓			✓					✓	✓				✓				✓	✓		
DINING	✓					✓					✓	✓	✓		✓			✓		✓	✓		
LIVING	✓					✓					✓	✓			✓			✓		✓	✓		see owner for carpet
GARAGE				✓			✓	✓						✓		✓				✓	✓		

DOOR SCHEDULE

DOOR	WIDTH	HEIGHT	THICKNESS	MATERIAL	TYPE	STORM DOOR	QUANTITY	THRESHOLD	REMARKS	MANUFACTURER
2068	2'-0"	6'-8"	1 3/8"	Wood-Ash	Hollow core	No	5	None	oil stain	L.B.J. Door, Inc.
2468	2'-4"	6'-8"	1 3/8"	Wood-Ash	Hollow core	No	1	None	Oil stain	L.B.J. Door. Inc.
2668	2'-6"	6'-8"	1"	Wood-Ash	cafe	No	1pr.	None	Oil stain	L.B.J. Door. Inc.
2668	2'-6"	6'-8"	1 3/8"	Wood-Ash	Sliding-Pocket	No	1	None	Oil Stain	L.B.J. Door Inc.
2668	2'-6"	6'-8"	1 3/8"	Wood-Ash	Hollow core	1 Screen	6	1 Alum.	Screen door in garage	L.B.J. Door Inc.
2868	2'-8"	6'-8"	1 3/4"	Metal Clad	Fireproof	Yes	1	Alum.	Paint	L.B.J. Door Inc.
3068	3'-0"	6'-8"	1 3/4"	Wood-Ash	Solid Core	No	1	None	Oil stain	L.B.J. Door Inc.
3668	3'-6"	6'-8"	1 3/4"	Wood-Ash	Solid Core	YES	1	Alum.	Marine Varnish	L.B.J. Door Inc.
6066	6'-0"	6'-6"	1/2"	Glass+Metal	Sliding	Yes	1pr.	Alum	Sliding screen	L.B.J. Door Inc.
6068	6'-0"	6'-8"	1 1/4"	Wood-Ash	Bi Fold	No	2 sets	None	Oil stain	L.B.J Door Inc.
1956	1'-9"	5'-6"	1/2"	Glass & Metal	Sliding Shower door	No	2 sets	None	Frosted glass	L.B.J. Door Inc.

WINDOW SCHEDULE

SYMBOL	WIDTH	HEIGHT	MATERIAL	TYPE	SCREEN & STORM	QUANTITY	REMARKS	MANUFACTURER	CATALOG NUMBER
A	3'-8"	3'-0"	Aluminum	Double Hung	Yes	2	4 Lights 4 High	LBJ Window Co.	141 PW
B	3'-8"	5'-0"	Aluminum	Double Hung	Yes	1	4 Lights 4 High	LBJ Window Co.	145 PW
C	3'-0"	5'-0"	Aluminum	Stationary	STORM ONLY	2	Single Lights	H&J Glass Co.	59 PY
D	2'-0"	3'-0"	Aluminum	Double Hung	Yes	1	4 Lights 4 High	LBJ Window Co	142 PW
E	2'-0"	6'-0"	Aluminum	Stationary	STORM ONLY	2	20 Lights	H&J Glass Co.	37 TS
F	3'-6"	5'-0"	Aluminum	Double Hung	Yes	1	16 Lights 4 High	LBJ Window Co.	141 PW

HEADER SCHEDULE

HEADER SIZE	EXTERIOR		INTERIOR	
	26' + Under	26' to 32'	26' + Under	26' to 32'
2-2x4	3'-6"	3'-0"	Use 2-2x6	
2-2x6	6'-6"	6'-0"	4'-0"	3'-0"
2-2x8	8'-6"	8'-0"	5'-6"	5'-0"
2-2x10	11'-0"	10'-0"	7'-0"	6'-6"
2-2x12	13'-6"	12'-0"	8'-6"	8'-0"

SCHEDULES

ASSIGNMENT SHEET SUPPLEMENT #1

FCCM - 285-B

SHEET 11

FHA Form 2005
VA Form 26-1852
Rev. 2/75

U. S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL HOUSING ADMINISTRATION
For accurate register of carbon copies, form may be separated along above fold. Staple completed sheets together in original order.

Form Approved
OMB No. 63-R0055

ASSIGNMENT SHEET SUPPLEMENT #2

FCCM - 287-B

☐ Proposed Construction

DESCRIPTION OF MATERIALS

No. ______ (To be inserted by FHA or VA)

☐ Under Construction

Property address Plan # City ______ State Oklahoma

Mortgagor or Sponsor ______ (Name) ______ (Address)

Contractor or Builder ______ (Name) ______ (Address)

INSTRUCTIONS

1. For additional information on how this form is to be submitted, number of copies, etc., see the instructions applicable to the FHA Application for Mortgage Insurance or VA Request for Determination of Reasonable Value, as the case may be.

2. Describe all materials and equipment to be used, whether or not shown on the drawings, by marking an X in each appropriate check-box and entering the information called for in each space. If space is inadequate, enter "See misc." and describe under item 27 or on an attached sheet. THE USE OF PAINT CONTAINING MORE THAN ONE HALF OF ONE PERCENT LEAD BY WEIGHT IS PROHIBITED.

3. Work not specifically described or shown will not be considered unless required, then the minimum acceptable will be assumed. Work exceeding minimum requirements cannot be considered unless specifically described.

4. Include no alternates, "or equal" phrases, or contradictory items. (Consideration of a request for acceptance of substitute materials or equipment is not thereby precluded.)

5. Include signatures required at the end of this form.

6. The construction shall be completed in compliance with the related drawings and specifications, as amended during processing. The specifications include this Description of Materials and the applicable Minimum Property Standards.

1. EXCAVATION:

Bearing soil, type Firm clay; Note: Where fill is in excess of 18", concrete piers to be installed at 8' oc and the cost will be added to the contract.

2. FOUNDATIONS:

Footings: concrete mix transite 14"x18" ftg; strength psi 2500 PSI concrete Reinforcing (4) 5/8" steel rebar
Foundation wall: material 2500 PSI concrete Reinforcing ______
Interior foundation wall: material 2500 PSI concrete Party foundation wall 2500 PSI concrete
Columns: material and sizes ______ Piers: material and reinforcing ______
Girders: material and sizes ______ Sills: material west coast utility Douglas fir with sill sealer
Basement entrance areaway ______ Window areaways ______
Waterproofing waterproof mix in concrete Footing drains open mortar joints
Termite protection pretreat soil and stem wall with Chlordane and issue 5 year warranty.
Basementless space: ground cover ______; insulation ______; foundation vents ______
Special foundations thicken slab beam with 2- 5/8" steel rebars to undisturbed soil.
Additional information: see patio details, also porch and fireplace footing.

3. CHIMNEYS:

Material brick Prefabricated *(make and size)* ______
Flue lining: material terra cotta Heater flue size 6" metalbestos Fireplace flue size 12"x12"
Vents *(material and size)*: gas or oil heater ______; water heater metalbestos
Additional information: ______

4. FIREPLACES:

Type: ☐ solid fuel; ☒ gas-burning; ☐ circulator *(make and size)* 42" vestal damper Ash dump and clean-out metal
Fireplace: facing brick; lining firebrick; hearth brick; mantel wood
Additional information: note: fireplace stubbed and keyed for gas outlet.

5. EXTERIOR WALLS: 2 x 4 studs @ 16"oc 1/2" plywood at corners.

Wood frame: wood grade, and species w.c. utility d.f. ☒ Corner bracing. Building paper or felt 15# felt
Sheathing flintcoat polyurethane; thickness 3/4"; width 24"; ☒ solid; ☐ spaced ______" o. c.; ☐ diagonal; ______
Siding ______; grade ______; type ______; size ______; exposure ______"; fastening ______
Shingles ______; grade ______; type ______; size ______; exposure ______"; fastening ______
Stucco ______; thickness ______"; Lath ______; weight ______ lb.
Masonry veneer face brick Sills brick Lintels steel supporting brick Base flashing ______
Masonry: ☐ solid ☐ faced ☐ stuccoed; total wall thickness ______"; facing thickness ______"; facing material ______
Backup material ______; thickness ______"; bonding ______
Door sills ______ Window sills ______ Lintels ______ Base flashing ______
Interior surfaces: dampproofing, ______ coats of ______; furring ______
Additional information: two coats of exterior paint or stain as selected by owner.
Exterior painting: material ______; number of coats ______
Gable wall construction: ☐ same as main walls; ☒ other construction cedar plywood or vertical siding as shown on elevations.

6. FLOOR FRAMING:

Joists: wood, grade, and species ______; other ______; bridging ______; anchors 1/2"x8"
Concrete slab: ☐ basement floor; ☐ first floor; ☒ ground supported; ☐ self-supporting; mix 3500 PSI concrete; thickness 4"";
reinforcing 6x6-W1.4xW1.4 WWF; insulation 1" perimeter; membrane waterproof concrete
Fill under slab: material sand fill; thickness 4". Additional information: ______

7. SUBFLOORING: *(Describe underflooring for special floors under item 21.)*

Material: grade and species 3/4" AC exterior plywood; size ______; type ______
Laid: ☐ first floor; ☐ second floor; ☒ attic 200 sq. ft sq. ft.; ☐ diagonal; ☐ right angles. Additional information: ______

8. FINISH FLOORING: *(Wood only. Describe other finish flooring under item 21.)*

Location	Rooms	Grade	Species	Thickness	Width	Bldg. Paper	Finish
First floor	living area, formal dining.						
Second floor	hall and bedrooms: pad and carpet installed:						allowance per square foot
Attic floor	sq. ft.						

Additional information: ______

DESCRIPTION OF MATERIALS

ASSIGNMENT SHEET SUPPLEMENT #2

288-B

9. PARTITION FRAMING:

Studs: wood, grade, and species w.c. utility d.f. size and spacing 2x4 studs @16"oc Other ______

Additional information: NOTE: 2 x 6 studs where needed for plumbing vents.

10. CEILING FRAMING:

Joists: wood, grade, and species w.c. standard d.f. Other see floor plan Bridging 2x4 flat and 2x6 up midspan stiffener

Additional information: see typical sheet for construction details.

11. ROOF FRAMING:

Rafters: wood, grade, and species w.c. utility d.f. Roof trusses (see detail): grade and species ______

Additional information: 2x6 rafters @24"oc, unless spans exceed allowable.

12. ROOFING:

Sheathing: wood, grade, and species west coast utility Douglas fir ; ☐ solid; ☒ spaced ____" o.c.

Roofing 240 #3 tab sq. butt asphalt shingles ; grade #1 ; size ______; type ______

Underlay ______ ; weight or thickness 5/2 ; size 16" ; fastening nail

Built-up roofing ______ ; number of plies ______ ; surfacing material ______

Flashing: material galvanized iron ; gage or weight 26 gauge ; ☐ gravel stops; ☐ snow guards

Additional information: ______

13. GUTTERS AND DOWNSPOUTS: Gutter over entryway

Gutters: material galvanized iron ; gage or weight 26 gauge size 5" ; shape o-gee

Downspouts: material galvanized iron; gage or weight 26 gauge size 3"x4" ; shape square ; number as need

Downspouts connected to: ☐ Storm sewer; ☐ sanitary sewer; ☐ dry-well. ☒ Splash blocks: material and size ______

Additional information: ______

14. LATH AND PLASTER

Lath ☐ walls, ☐ ceilings: material ______; weight or thickness ______ Plaster: coats ____; finish ______

Dry-wall ☒ walls, ☒ ceilings: material Sheetrock ; thickness 1/2" ; finish medium texture ;

Joint treatment mud and tape; NOTE: Sheetrock applied according to manufacturer's specs.

15. DECORATING: *(Paint, wallpaper, etc.)*

Rooms	Wall Finish Material and Application	Ceiling Finish Material and Application
Kitchen		
Bath ALL ROOMS:	paint and/or wallpaper	all ceilings to be textured
Other		and painted two coats flat paint.
	WALLPAPER ALLOWANCE: $	(includes cost of labor)

Additional information: PANELING: 1/4" v-groove ash

16. INTERIOR DOORS AND TRIM:

Doors: type hollow core slab ; material ash or birch ; thickness 1-3/8"

Door trim: type detail ; material white pine Base: type detail ; material white pine ; size 3-1/4"

Finish: doors hand-rubbed stain ; trim hand-rubbed stain

Other trim *(item, type and location)* Note: All headers to meet schedule as shown on detail sheet.

Additional information: ______

17. WINDOWS: ALL THERMOPANE GLASS- fixed and operating.

Windows: type single hung ; make Alenco or equal ; material aluminum ; sash thickness 1"

Glass: grade DS6 ; ☐ sash weights; ☒ balances, type spring ; head flashing galvanized

Trim: type Sheetrock return ; material Sheetrock Paint texture & paint ; number coats 2

Weatherstripping: type with units ; material wool pile Storm sash, number ______

Screens: ☒ full; ☐ half; type metal or aluminum ; number all ; screen cloth material 16" aluminum mesh

Basement windows: type ______; material ______; screens, number ______; Storm sash, number ______

Special windows See plans for fixed windows

Additional information: NOTE: Sheetrock return on all windows with wood stool and apron.

18. ENTRANCES AND EXTERIOR DETAIL:

Main entrance door: material ash panel ; width see plans ; thickness 1-3/4" Frame: material w. pine , thickness 1-1/8"

Other entrance doors: material w.p. m.c. ; width see plans ; thickness 1-3/4" Frame: material w. pine ; thickness 1-1/8"

Head flashing galvanized iron Weatherstripping: type spring bronze ; thresholds; aluminum

Screen doors: thickness ____"; number ______; screen cloth material ______ Storm doors: thickness ____"; number ______

Combination storm and screen doors: thickness ____"; number ____; screen cloth material ______

Shutters: ☐ hinged; ☐ fixed. Railings ______, Attic louvers galvanized back screen in soffit

Exterior millwork: grade and species redwood or rough cedar Paint exterior paint or stain; number coats 2

Additional information: Thermopane glass sliding doors with alum. frame

19. CABINETS AND INTERIOR DETAIL:

Kitchen cabinets, wall units: material ash with white pine stiles ; lineal feet of shelves ______; shelf width 12"

Base units: material ash with white pine; counter top Formica ; edging self-edge Formica

Back and end splash full Formica Finish of cabinets enamel or hand-rubbed stain; number coats 5

Medicine cabinets: make ______; model ______

Other cabinets and built-in furniture Ash raised panel door and drawer fronts--shop built

Additional information: built-in vanities with synthetic marble or Formica top and splash; built-in ash bookcases (See plans)

20. STAIRS:

Stair	Treads		Risers		Strings		Handrail		Balusters	
	Material	Thickness	Material	Thickness	Material	Size	Material	Size	Material	Size
Basement										
Main										
Attic										

Disappearing: make and model number pull-down ladder to attic access in garage.2040

Additional information: ______

21. SPECIAL FLOORS AND WAINSCOT:

	Location	Material, Color, Border, Sizes, Gage, Etc.	Threshold Material	Wall Base Material	Underfloor Material
Floors	Kitchen	utility: sheet vinyl			
	Baths	ceramic tile	ceramic	white pine	concrete
	Main entry	earthstone	aluminum	white pine	concrete
	Rear entry	sheet vinyl	aluminum		concrete

	Location	Material, Color, Border, Cap. Sizes, Gage, Etc.	Height	Height Over Tub	Height in Showers (From Floor)
Wainscot	Bath	(tub & shower ceramic tile over metl lath and grout area only)		72"	72"
	remainder of				
	bath walls:	1/4 " v-groove ash wainscoting 32 " high			

Bathroom accessories: ☐ Recessed; material brushed chrome; number ____; ☐ Attached; material brushed chrome; number ____

Additional information: ____

22. PLUMBING:

Fixture	Number	Location	Make	Mfr's Fixture Identification No.	Size	Color
Sink	1	kitchen	Kohler	Delafield k-5950	32"x21"	color
Lavatory		baths	Kohler	Caxton k-2210	19"x15"	color
Water closet		baths	Kohler	Wellsworth k-3500 eb	reverse trap	color
Bathtub		bath	Kohler	Villager k-715	60"	color
Shower over tub△		bath	Kohler	chrome divertor over tub		
Stall shower△		bath	ceramic stall shower with glass door (job built)			
Laundry trays						
optional:	1	Kohler party bar sink with single lever faucet in utility rm.				
	NOTE: Kohler faucets on all lavatories and sinks.					

△☒ Curtain rod △☒ Door ☐ Shower pan: material ____

Water supply: ☒ public; ☐ community system; ☐ individual (private) system.★

Sewage disposal: ☒ public; ☐ community system; ☐ individual (private) system.★

★Show and describe individual system in complete detail in separate drawings and specifications according to requirements.

House drain (inside): ☐ cast iron; ☐ tile; ☒ other ABS or PVC House sewer (outside): ☐ cast iron; ☒ tile; ☐ other 4" ABS

Water piping: ☐ galvanized steel; ☒ copper tubing; ☐ other type L hard-drawn joints. Sill cocks, number frostproof

Domestic water heater: type automatic; make and model Rheem or State; heating capacity 40 gallons 25.2 gph. 100° rise. Storage tank: material glass lined; capacity 40 gallons.

Gas service: ☒ utility company; ☐ liq. pet. gas; ☐ other ____ Gas piping: ☐ cooking; ☒ house heating.

Footing drains connected to: ☐ storm sewer; ☐ sanitary sewer; ☐ dry well. Sump pump; make and model ____; capacity ____; discharges into ____

23. HEATING:

☐ Hot water. ☐ Steam. ☐ Vapor. ☐ One-pipe system. ☐ Two-pipe system.

☐ Radiators. ☐ Convectors. ☐ Baseboard radiation. Make and model ____

Radiant panel: ☐ floor; ☐ wall; ☐ ceiling. Panel coil: material ____

☐ Circulator. ☐ Return pump. Make and model ____; capacity ____ gpm.

Boiler: make and model ____ Output ____ Btuh.; net rating ____ Btuh.

Additional information: ____

Warm air: ☐ Gravity. ☒ Forced. Type of system perimeter under floor

Duct material: supply concrete; return sheet metal Insulation fiberglass thickness 1" ☐ Outside air intake.

Furnace: make and model See heating and air conditioning Input 120,000 Btuh.; output 96,000 Btuh.

Additional information: Layout; to be prepared by mechanical contractor.

☐ Space heater; ☐ floor furnace; ☐ wall heater. Input ____ Btuh.; output ____ Btuh.; number units ____

Make, model ____ Additional information: ____

Controls: make and types ____

Additional information: ____

Fuel: ☐ Coal; ☐ oil; ☐ gas; ☐ liq. pet. gas; ☐ electric; ☐ other ____; storage capacity ____

Additional information: ____

Firing equipment furnished separately: ☐ Gas burner, conversion type. ☐ Stoker: hopper feed ☐; bin feed ☐

Oil burner: ☐ pressure atomizing; ☐ vaporizing ____

Make and model ____ Control furnace in garage.

Additional information: NOTE: Gas outlet for hot water tank, furnace, fireplace jet, and wall

Electric heating system: type ____ Input ____ watts; @ ____ volts; output ____ Btuh.

Additional information: ____

Ventilating equipment: attic fan, make and model ____; capacity 7,800 cfm.

kitchen exhaust fan, make and model kitchen vent hood and exhaust fan.

Other heating, ventilating, or cooling equipment Nutone or equal ceiling heaters in baths.

24. ELECTRIC WIRING:

allow for 200 amp service

Service: ☐ overhead; ☐ underground. Panel: ☐ fuse box; ☒ circuit-breaker; make square D AMP's as required No. circuits ____

Wiring: ☐ conduit; ☒ armored cable; ☐ nonmetallic cable; ☐ knob and tube; ☐ other romex wiring if code allows

Special outlets: ☒ range; ☐ water heater; ☐ other 220 volt for oven, range, dryer, and air conditioning

☐ Doorbell. ☒ Chimes. Push-button locations ____ Additional information: ____

25. LIGHTING FIXTURES:

Total number of fixtures see plans Total allowance for fixtures, typical installation, $ ____

Nontypical installation ____

Additional information: Optional Fluorescent grid, dropped ceiling in kitchen as shown on plans

26. INSULATION:

LOCATION	THICKNESS	MATERIAL, TYPE, AND METHOD OF INSTALLATION	VAPOR BARRIER
Roof			
Ceiling	12"	loose-fill fiberglass insulation in ceiling of house only	(blown between jsts)
Wall	4"	batts- fiberglass insulation- exterior walls of house	(stapled to studs)
Floor	1"	perimeter insulation under slab.	

27. MISCELLANEOUS: *(Describe any main dwelling materials, equipment, or construction items not shown elsewhere; or use to provide additional information where the space provided was inadequate. Always reference by item number to correspond to numbering used on this form.)*

LIGHTING FIXTURES. . . . . . . $ as per contract
WALLPAPER. . . . . $ per contract labor and material
LANDSCAPING. . . . . $ as per contract
CARPET ALLOWANCE. . . . . . . $ PER SQUARE YARD INSTALLED as per contract
Cabinet over washer and dryer.
Waterproof outlet on patio.

HARDWARE: *(make, material, and finish.)*

Dexter or equal passage sets and locks- all exterior doors keyed alike
deadbolt locks on all exterior doors.

SPECIAL EQUIPMENT: *(State material or make, model and quantity. Include only equipment and appliances which are acceptable by local law, custom and applicable FHA standards. Do not include items which, by established custom, are supplied by occupant and removed when he vacates premises or chattles prohibited by law from becoming realty.)*

APPLIANCE ALLOWANCE: $
AS SELECTED BY OWNER WITHIN SPECIFIED ALLOWANCE

PORCHES:

foundation construction: 6" x 8" poured monolithic with the slab.
floor: 4" concrete slab with 6x6-W1.4xW1.4 WWF smooth trowel finish.

TERRACES:

stoops: 4" concrete slab- smooth trowel finish.
patio: 4" concrete slab- smooth trowel finish. - see plans for size.

GARAGES: automatic garage door opener
foundation: 14" x 18" concrete footing with (4) 5/8" rebars; 6" concrete stem wall
floor: 4" concrete with 6x6-W1.4xW1.4 WWF; smooth trowel finish floors.
interior: 3/8" prefinished Sheetrock on walls; texture and paint 1/2" Sheetrock on ceiling

WALKS AND DRIVEWAYS:

Driveway: width see plot base material tamped earth ; thickness 4 "; surfacing material concrete ; thickness 4 "
Front walk: width 36" ; material concrete; thickness 4 ". Service walk: width ____; material ____; thickness ____"
Steps: material ____; treads ____"; risers ____". Cheek walls ____

OTHER ONSITE IMPROVEMENTS:

(Specify all exterior onsite improvements not described elsewhere, including items such as unusual grading, drainage structures, retaining walls, fence, railings, and accessory structures.)

NOTE: All dimensions to be rechecked on site prior to beginning construction by builder and builder shall be responsible for the same.

LANDSCAPING, PLANTING, AND FINISH GRADING:

Topsoil ____" thick: ☐ front yard; ☐ side yards; ☐ rear yard to ____ feet behind main building.
Lawns *(seeded, sodded, or sprigged)*: ☐ front yard ____; ☐ side yards ____; ☐ rear yard ____
Planting: ☐ as specified and shown on drawings; ☐ as follows:

____ Shade trees, deciduous, ____" caliper.
____ Low flowering trees, deciduous, ____' to ____'
____ High-growing shrubs, deciduous, ____' to ____'
____ Medium-growing shrubs, deciduous, ____' to ____'
____ Low-growing shrubs, deciduous, ____' to ____'
____ Evergreen trees. ____' to ____', B & B.
____ Evergreen shrubs. ____' to ____', B & B.
____ Vines, 2-year ____

IDENTIFICATION.—This exhibit shall be identified by the signature of the builder, or sponsor, and/or the proposed mortgagor if the later is known at the time of application.

Date ____ Signature ____

Signature ____

ASSIGNMENT SHEET SUPPLEMENT #2

290-B

GPO : 1976 O - 219-069

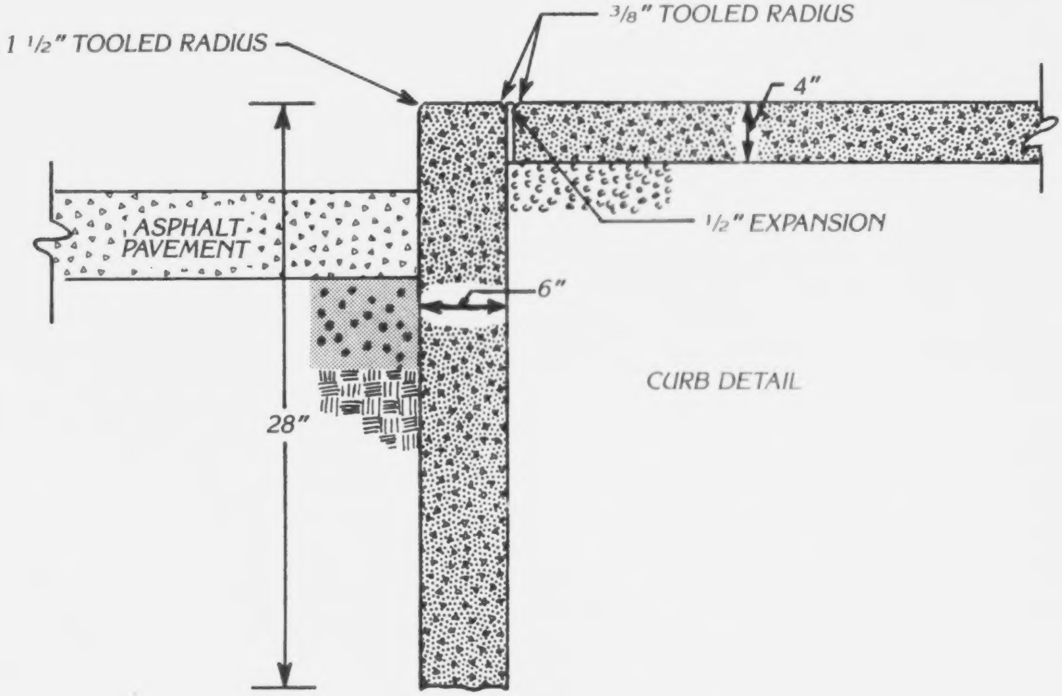
BASIC PLAN READING
UNIT III

ASSIGNMENT SHEET #1 — INTERPRET A DRAWING

NAME ________________________ SCORE ______________

PART I

Study the curb detail below, and then list four different materials shown.


3/8" TOOLED RADIUS
1 1/2" TOOLED RADIUS
4"
ASPHALT PAVEMENT
1/2" EXPANSION
6"
28"
CURB DETAIL

A. ______________________________

B. ______________________________

C. ______________________________

D. ______________________________

ASSIGNMENT SHEET #1

PART II

List the different types of lines that are used on the curb detail on the previous page.

A. ____________________

B. ____________________

C. ____________________

D. ____________________

E. ____________________

BASIC PLAN READING
UNIT III

ASSIGNMENT SHEET #2 — READ PLANS

NAME ______________________________ SCORE ______________

A concrete mason learns to read plans by learning what information each type of drawing in a set of plans contains, by learning the meanings of the architectural terms used for each part of a building, by understanding the many abbreviations used in plans, by learning to visualize plans drawn to scales that are only fractional parts of full size, by being thoroughly acquainted with all dimensioning procedures, and by being able to recognize the many types of lines used on plans. Once you have learned these basics, you will be able to visualize. Each mark on the plan will mean something to you, just as the letters of the alphabet mean something when you are reading this paragraph.

This assignment sheet is designed to help you become more familiar with the different drawings in a set of plans. It should also give you an idea of what to look for when reading plans, and should provide practice for learning the fundamentals of plan reading. Refer to the set of plans in Assignment Sheet Supplement #1 to answer the following questions. Remember that you may have to refer to detail and section drawings to answer all questions about a plan.

A. Plot plan

________________ 1. What are the overall outside dimensions of the building?

________________ 2. What is the elevation of the benchmark?

________________ 3. What is the width and length of the drive?

________________ 4. In what direction does the residence face?

________________ 5. How far is the residence from the east property line?

________________ 6. What is the width of the sidewalk?

________________ 7. How far is the northeast corner of the residence from the north property line?

________________ 8. How far is the southwest corner of the residence from the south property line?

________________ 9. What is the finish floor elevation?

________________ 10. What is the scale of this drawing?

B. Foundation plan

________________ 1. How thick is the concrete slab in the garage?

ASSIGNMENT SHEET #2

________ 2. What size and type of reinforcing is used in the building slab?

________ 3. How wide is the footing on the building?

________ 4. How wide are the stem walls?

________ 5. What is the drop from finish grade to the porch slab?

________ 6. What strength of concrete is used?

________ 7. How many reinforcing rods are used in the exterior footings?

________ 8. What is the radius of the garage floor at the door edge?

________ 9. What size anchor bolts are to be used throughout?

________ 10. How much is the garage floor sloped from the inside wall out?

________ 11. What type of insulation is used for the vapor barrier?

________ 12. In which detail are the stem wall and the floor poured monolithic?

________ 13. What is the depth of the fireplace footing?

________ 14. On which details do you find expansion joints?

________ 15. What material is used as fill beneath the concrete slab?

C. Floor plan

________ 1. What is the size of the porch?

________ 2. What is the height of the fireplace hearth?

________ 3. What material is used around the perimeter of the garage?

________ 4. What is the width of the sidewalk?

________ 5. What is the thickness of the expansion material used in garage?

________ 6. How many square feet of living space will there be?

________ 7. How much drop is there from the garage floor to the apron?

ASSIGNMENT SHEET #2

______________ 8. What is the thickness of the exterior walls?

______________ 9. How far is the sidewalk from south side of garage?

______________ 10. What is the size of the patio?

______________ 11. What are the dimensions of the planter?

______________ 12. What is the radius of the curved edges of the patio?

______________ 13. Of what material is the planter made?

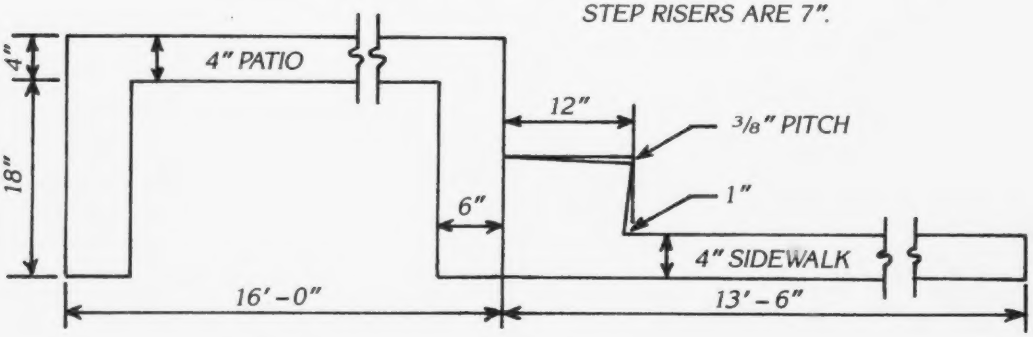
______________ 14. What is the depth of the garage floor?

BASIC PLAN READING
UNIT III

ASSIGNMENT SHEET #3 — READ DETAILS

NAME ______________________________ SCORE ________________

From the drawing below, list dimensions of the patio, sidewalk, step, and patio footing.


STEP RISERS ARE 7".
4"
4" PATIO
18"
12"
3/8" PITCH
1"
6"
4" SIDEWALK
16'-0"
13'-6"

STEP DETAIL
SECTION VIEW

A. Patio thickness ______________________________

B. Sidewalk thickness ______________________________

C. Step height and width ______________________________

D. Patio footing width and depth ______________________________

BASIC PLAN READING
UNIT III

ASSIGNMENT SHEET #4 — READ WRITTEN SPECIFICATIONS

NAME ________________________________ SCORE ______________

Both specifications and plans may indicate information about the same items. The symbols and notes appearing on an elevation or plan view, for example, may completely describe a certain aspect of construction. In that event, the written specifications need not repeat the same information. When, however, symbols and notes do not contain complete information, then specifications must include whatever additional information may be required. For example, section and detail views may indicate that subflooring is required. That is not enough information. So, the specifications would have to show the size of the boards to use, the type of boards to use, how the boards are to be mill-finished, and how nailed. Therefore, when you study plans and specifications, you must pay careful attention to what is shown on the plans, as well as to what is set forth in the specifications. A good concrete mason cannot possibly obtain a full understanding of all requirements until he or she is thoroughly familiar with both plans and written specifications.

Use the set of written specifications in Assignment Sheet Supplement #1 to answer the following questions. Do not use abbreviations in your answers.

A. What restriction is applied to the general type of paint that may be used?

____

B. Foundation

1. Under what conditions must concrete piers be installed?

____

2. What type of reinforcing is to be used in the foundation? ______________

3. Of what material are the foundation sills to be made?

____

4. How is the foundation to be waterproofed?

____

5. With what is the soil to be treated to protect against termites? ______________

C. Chimneys and fireplaces

1. What is the size of the fireplace flue? ______________________

2. What type of flue-liner material is to be used? ______________________

ASSIGNMENT SHEET #4

3. What material is to be used in the fireplace hearth? ______________________________

4. List additional information given for the fireplace specifications.

   ____

D. Floors and exterior walls

1. What is the strength of the concrete used in the floor?

   ____

2. What type of reinforcing is to be used in the floor?

   ____

I. Miscellaneous

1. What is to be the finish on the concrete of the porch floor, stoops, and patio?

   ____

2. With what will the interior walls of the garage be finished?

   ____

3. Will the driveway be asphalt, gravel, or concrete?______________________________

BASIC PLAN READING
UNIT III

ASSIGNMENT SHEET #5 — READ AN ARCHITECT'S SCALE

NAME ______________________________ SCORE ______________

Concrete masons need to be skilled in using an architect's scale. Learning to read an architect's scale proficiently also aids in reading plans.

Use an architect's scale to complete this assignment sheet. Keep in mind the following guidelines.

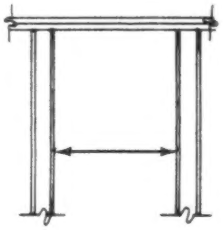
- Select proper scale ratio.
- Be sure that scale is lying flat on surface being measured.
- Double-check all measurements.
- Practice measuring from center of one line to center of next line.
- Do not use scale if dimensions are available.

(NOTE: Accuracy may vary because of distortion due to the printing process.)

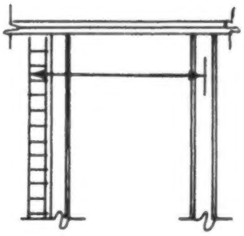
PART I

Use the architect's scale to find the following dimensions. Write your answers in the blanks.

______________A. Scale to 1/16" = 1'-0"

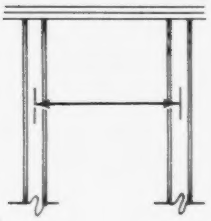


______________B. Scale to 1/8" = 1'-0"

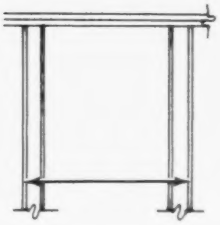


ASSIGNMENT SHEET #5

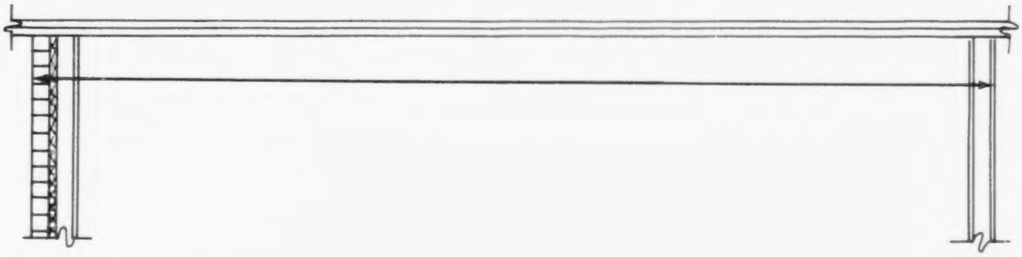
____________________C. Scale to 1/4" = 1'-0"



____________________D. Scale to 1/2" = 1'-0"



____________________E. Scale to 1 1/2" = 1'-0"

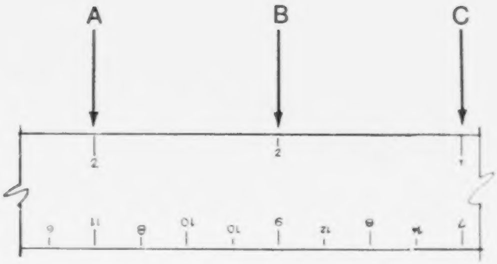


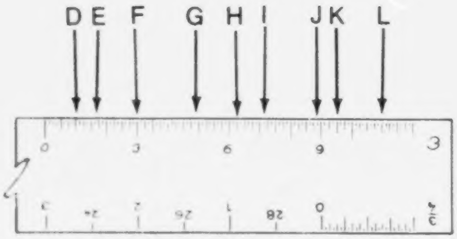
PART II

Read the following scales from zero to the letter points indicated. Write the correct readings in the blanks below the scales.

ASSIGNMENT SHEET #5

A.

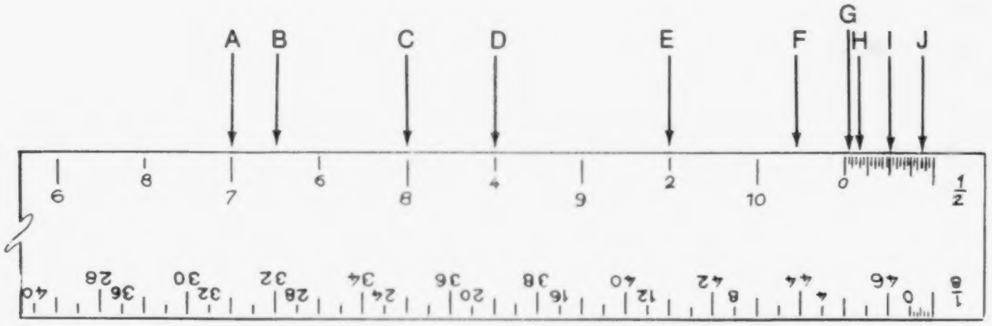




(NOTE: This illustration has been reduced).

1. A = ______________________
2. B = ______________________
3. C = ______________________
4. D = ______________________
5. E = ______________________
6. F = ______________________
7. G = ______________________
8. H = ______________________
9. I = ______________________
10. J = ______________________
11. K = ______________________
12. L = ______________________

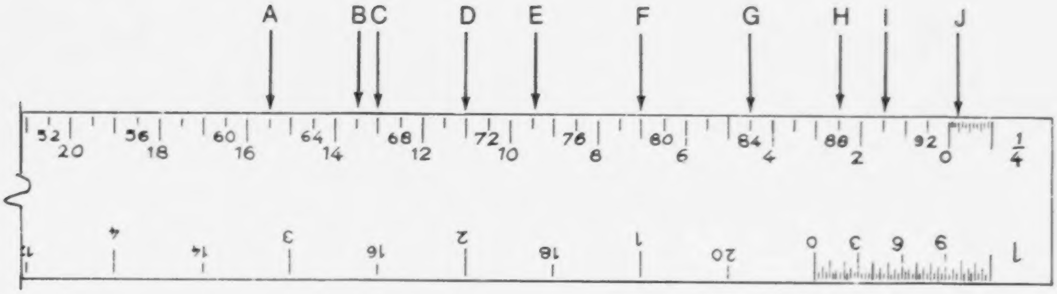
B.


A
B
C
D
E
F
G
H
I
J

1. A = ______________________
2. B = ______________________
3. C = ______________________
4. D = ______________________
5. E = ______________________
6. F = ______________________
7. G = ______________________
8. H = ______________________
9. I = ______________________
10. J = ______________________

ASSIGNMENT SHEET #5

C.


A
B
C
D
E
F
G
H
I
J
52
20
56
18
60
16
64
14
68
12
72
10
76
8
80
6
84
4
88
2
92
0
1/4
12
4
14
3
16
2
18
1
20
0
3
6
9
1

1. A = ________________

2. B = ________________

3. C = ________________

4. D = ________________

5. E = ________________

6. F = ________________

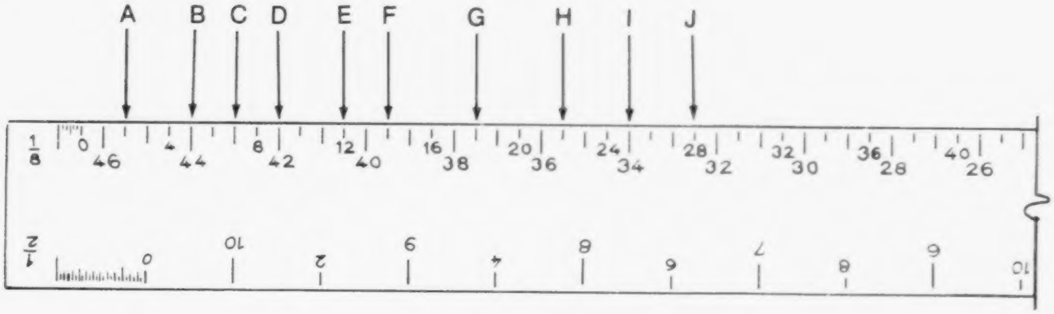
7. G = ________________

8. H = ________________

9. I = ________________

10. J = ________________

D.


A
B
C
D
E
F
G
H
I
J
1/8
0
46
4
44
8
42
12
40
16
38
20
36
24
34
28
32
32
30
36
28
40
26
1/2
0
10
2
9
4
8
6
7
8
9
10

1. A = ________________

2. B = ________________

3. C = ________________

4. D = ________________

5. E = ________________

6. F = ________________

7. G = ________________

8. H = ________________

9. I = ________________

10. J = ________________

BASIC PLAN READING
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

PART I

A. Concrete
B. Cinders
C. Gravel with sand
D. Earth

PART II

A. Object
B. Dimension
C. Extension
D. Break
E. Leaders

Assignment Sheet #2

A. 1. 51′-9″ × 57′-0″
2. 296′-4″
3. 16′-0″ × 49′-0″
4. West
5. 40′-0″
6. 3′-0″
7. 47′-6″
8. 27′-6″
9. 300′-10″
10. 1″ = 20′-0″

B. 1. 4″
2. W1.4 × W1.4 wire mesh
3. 14′
4. 6″
5. 3/4″
6. 3500#
7. Four
8. 3/4″
9. 1/2″ × 8″
10. 2″
11. Rigid
12. 7D
13. 12″
14. 7C and 7D
15. Sand

C. 1. 6′-0″ × 9′-6″
2. 12 1/2″
3. Expansion joint
4. 3 feet
5. 1/2 inch
6. Approx. 1900 square feet
7. 3/4 inch
8. 8 1/2″
9. 6′-1″
10. 14′-8″ × 28′-0″
11. 2′-0″ × 4′-2″ × 2′-4 1/8″
12. 4′
13. Brick
14. 4″

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #3

A. 4″

B. 4″

C. 7″, 12″

D. 6″,18″

Assignment Sheet #4

A. May not contain more than five-tenths of one-percent lead by weight

B.
1. Where fill is in excess of 18″
2. 5/8″ steel rebar
3. West coast utility Douglas fir
4. Sill sealer and waterproof mixture in concrete
5. Chlordane

C.
1. 12″ × 12″
2. Terra cotta
3. Brick
4. Fireplace is to be stubbed and keyed for gas outlet

D.
1. 3500#
2. W1.4 × W1.4

E.
1. Smooth trowel finish
2. 3/8″ prefinished sheetrock
3. Concrete

Assignment Sheet #5

PART I

(NOTE: Answers may vary slightly due to printing distortions.)

A. 11′−3″
B. 8′−1″
C. 3′−4″
D. 1′−11″
E. 3′−8″

PART II

A.
1. 2′−0″
2. 1′−6″
3. 1′−0″
4. 1″
5. 1 5/8″
6. 3″
7. 4 7/8″
8. 6 1/4″
9. 7 1/8″
10. 8 7/8″
11. 9 1/2″
12. 11″

ANSWERS TO ASSIGNMENT SHEETS

B.
1. 7′-0″
2. 6′-6″
3. 5′-0″
4. 4′-0″
5. 2′-0″
6. 6″
7. 1/2″
8. 2″
9. 6″
10. 10 1/2″

C.
1. 15′-6″
2. 13′-6″
3. 13′-0″
4. 11′-0″
5. 9′-6″
6. 7′-0″
7. 4′-6″
8. 2′-6″
9. 1′-6″
10. 3″

D.
1. 2′-0″
2. 5′-0″
3. 7′-0″
4. 9′-0″
5. 12′-0″
6. 14′-0″
7. 18′-0″
8. 22′-0″
9. 25′-0″
10. 28′-0″

BASIC PLAN READING
UNIT III

TEST

NAME ______________________________ SCORE ______________

1. Match terms associated with plan reading to their correct definitions. Write the correct numbers in the blanks. Terms and definitions continue on the next page.

______a. Lines used on plot plans and topographical surveys to show both natural grade and finish grade elevations

______b. Reproductions of architect's drawings; also called *plans* or *construction plans*

______c. Using conventional dimension lines and figures to indicate actual sizes and distances of objects and spaces represented

______d. Exact measured size of a unit

______e. Given grade

______f. Three-sided rule with six ruled faces designed to measure in twelve different scales of proportional feet and inches

______g. Important aspect of plan reading that involves looking at and thinking about a structural detail, or a symbol for such a detail, and being able to form a mental picture of how such a detail is constructed or assembled

______h. Drawing made to a size either proportionally larger or smaller than the actual size of the object represented

______i. Drawing having many of the features of a photograph; drawn by the architect to interest buyers

______j. Drawing showing location and details about plumbing and electrical components and heating and air-conditioning units

______k. Approximate or rough size of a unit

______l. Point of known or assumed elevation used by surveyor as a reference point in determining other elevations

1. Benchmark
2. Blueprints
3. Perspective drawing
4. Elevation
5. Mechanical drawing
6. Visualization
7. Nominal dimension
8. Actual dimension
9. Architect's scale
10. Scale drawing
11. Contour lines
12. Dimensioning

TEST

_____m. Detailed set of written instructions that supplements the set of plans, describes equipment and materials used in the structure, and becomes part of the contract

_____n. Listing or chart of parts (keyed to the plans), amounts, materials or products, and details

_____o. Drawing of natural and man-made features of a place or region showing their relative positions and elevations

_____p. Architect's standard methods of representing dimensions and structural details

_____q. Drawing by a structural engineer; may accompany architect's plans and give important information about the foundation, skeleton, and floor systems

_____r. Set of detailed working drawings or plans drawn to scale by an architect, showing all information and dimensions necessary to build or remodel a structure; original drawings from which blueprints are made

13. Structural drawing
14. Specifications
15. Convention
16. Topographical survey
17. Architect's drawings
18. Finish schedule

2. Match to their correct descriptions types of drawings usually included in a set of plans. Write the correct numbers in the blanks.

_____a. Horizontal view of building, showing length and breadth of building and layout of rooms on that floor

_____b. Horizontal view showing where the building is to be located on the site

_____c. Cut-away vertical view through an object or wall to show its interior makeup

_____d. Vertical, two-dimensional view of each of the exterior faces of a building, showing general shape and design of exterior and roof

_____e. Graphic, at a larger scale, of part of another drawing, indicating special features of design, location, and composition and the correlation of the elements and materials shown

_____f. Horizontal view of entire masonry substructure below first floor or frame of building

1. Plot plan
2. Foundation plan
3. Floor plan
4. Elevation
5. Section
6. Detail

TEST

3. List information found on types of drawings in a set of plans.

   a. Plot plan (List four.)

      1) ____________________
      2) ____________________
      3) ____________________
      4) ____________________

   b. Foundation plan (List two.)

      1) ____________________
      2) ____________________

   c. Floor plan (List five.)

      1) ____________________
      2) ____________________
      3) ____________________
      4) ____________________
      5) ____________________

   d. Elevation (List four.)

      1) ____________________
      2) ____________________
      3) ____________________
      4) ____________________

   e. Section (List three.)

      1) ____________________
      2) ____________________
      3) ____________________

   f. Detail (List six.)

      1) ____________________
      2) ____________________

TEST

3) ____________________

4) ____________________

5) ____________________

6) ____________________

4. Match lines in the alphabet of lines to their correct uses. Write the correct numbers in the blanks.

_____a. Used to connect a note or dimension to a related part of the drawing

_____b. Used to show main outline of structure, including exterior walls, interior partitions, porches, patios, sidewalks, parking lots, and driveways

_____c. Used as parameters for dimension lines

_____d. Used to designate object and area dimensions

_____e. Used to indicate alternate positions of moving parts, adjacent positions of related parts, and for repeated details

_____f. Used to indicate an area that has been cut away and shown in a section view; arrows indicate direction from which section drawing is to be viewed

_____g. Used to show an object or area that is not visible from view depicted

_____h. Used to show that an object or area has not been drawn in its entirety

_____i. Used to designate center and to provide a reference point for dimensioning

1. Object lines
2. Dimension line
3. Extension lines
4. Hidden line
5. Break line
6. Center line
7. Cutting-plane line (section line)
8. Phantom line
9. Leader line

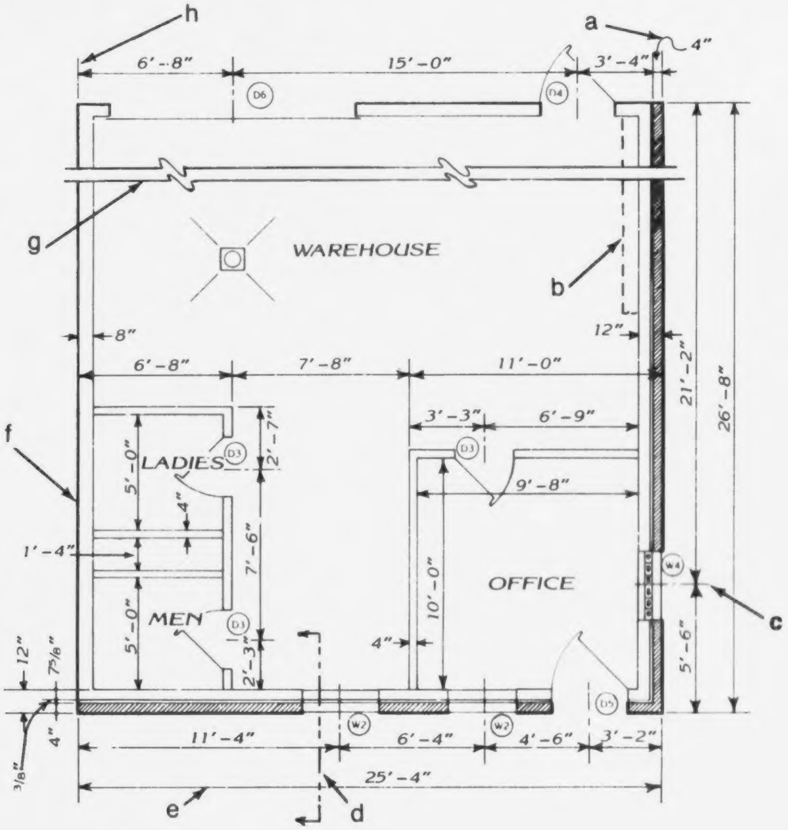
TEST

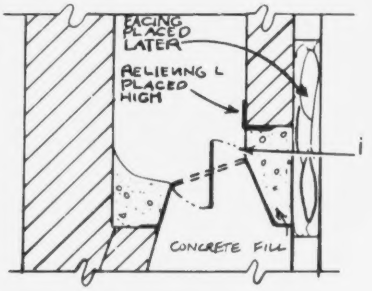
5. Identify lines in the alphabet of lines. Write the correct letters in the blanks.

_____**Object line**
_____**Dimension line**
_____**Extension line**

_____**Hidden line**
_____**Center line**
_____**Cutting-plane line (section line)**

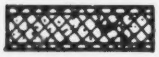
_____**Break line**
_____**Phantom line**
_____**Leader line**

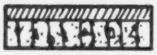

h
a
4"
6'-8"
15'-0"
3'-4"
D6
D4
g
WAREHOUSE
b
8"
12"
6'-8"
7'-8"
11'-0"
21'-2"
26'-8"
3'-3"
6'-9"
f
LADIES
D3
D3
2'-7"
5'-0"
4"
9'-8"
1'-4"
7'-6"
10'-0"
OFFICE
W4
c
MEN
D3
5'-0"
2'-3"
4"
5'-6"
12"
7 5/8"
4"
3/8"
D5
W2
W2
11'-4"
6'-4"
4'-6"
3'-2"
25'-4"
e
d

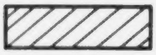

FACING PLACED LATER
RELIEVING L PLACED HIGH
i
CONCRETE FILL

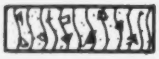
TEST

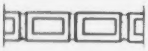
6. Identify the following selected architectural symbols commonly used to represent materials on plans. Write the correct names in the blanks.

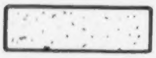

a. ________________________________

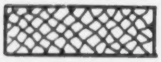

b. ________________________________

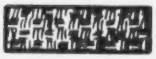

c. ________________________________

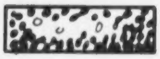

d. ________________________________

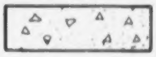

e. ________________________________

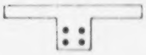

f. ________________________________

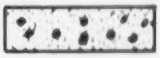

g. ________________________________

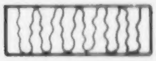

h. ________________________________

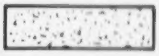

i. ________________________________

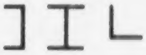

j. ________________________________

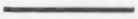

k. ________________________________


l. ________________________________


m. ________________________________


n. ________________________________


o. ________________________________


p. ________________________________

TEST

7. Identify the following selected abbreviations commonly used on plans. Write in the blanks the full word or words for the abbreviated word or words.

______________________________ a. 16" CC

______________________________ b. 3'–6" MO

______________________________ c. CONC B WALL

______________________________ d. EQUAL FROM CTR

______________________________ e. ½" EXP JT

______________________________ f. TC TILE

______________________________ g. ½" BRG PL

______________________________ h. FS DET

______________________________ i. 14 R

______________________________ j. REINF CONC APRON

______________________________ k. LINTEL ∠ IRON

______________________________ l. WH 48" OC

______________________________ m. SEE SPEC

______________________________ n. STR STL

______________________________ o. BM 114'

TEST

8. Match the following architect's conventions to their correct representations. Write the correct numbers in the blanks. Representations continue on the next page.

_____a. Doors and windows in brick veneer and wood stud walls

_____b. Doors and windows in concrete wall

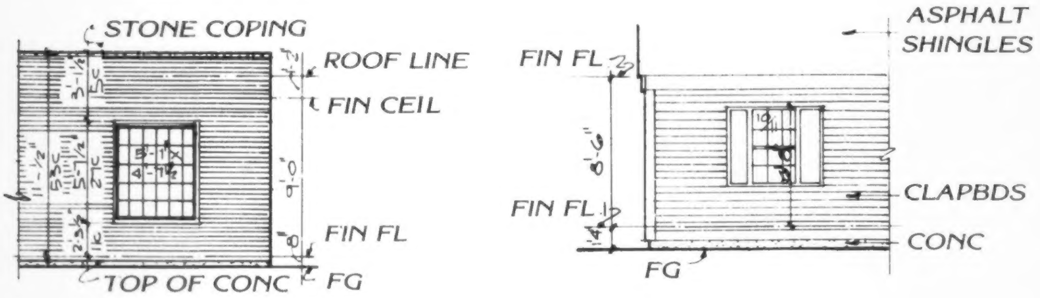
_____c. Dimensioning exterior and interior walls

_____d. Doors and windows in solid brick wall

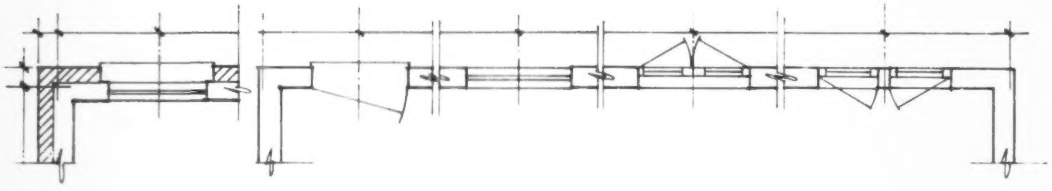
_____e. Window elevations

_____f. Interior dimensions and alterations

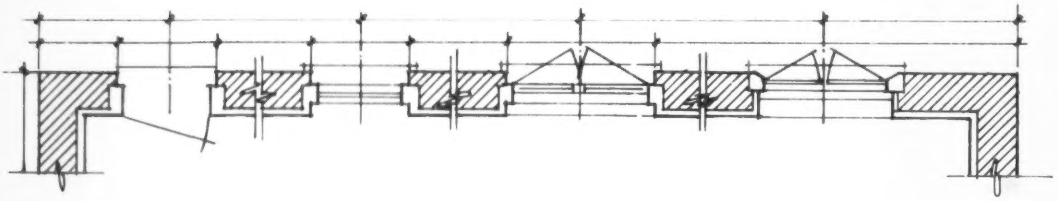
1)


STONE COPING
ROOF LINE
FIN CEIL
FIN FL
TOP OF CONC
FG
3'-1½"
5C
11'-1½"
53C
5'-1½"
21C
2'-5½"
1K
9'-0"
8"
5'-1½ x 4'-1½
ASPHALT SHINGLES
FIN FL
8'-6"
CLAPBDS
FIN FL
1'-4"
CONC
FG

2)

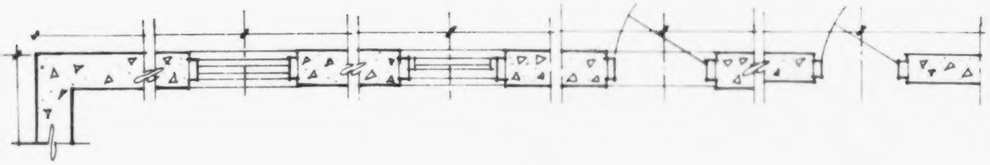


3)

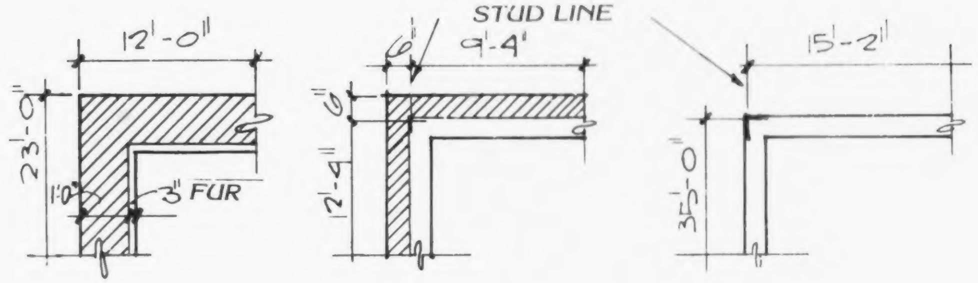


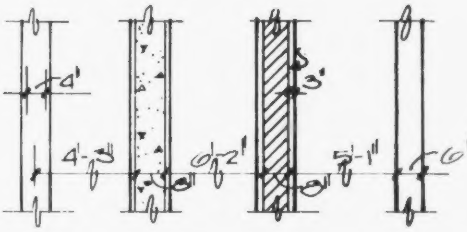
TEST

4)

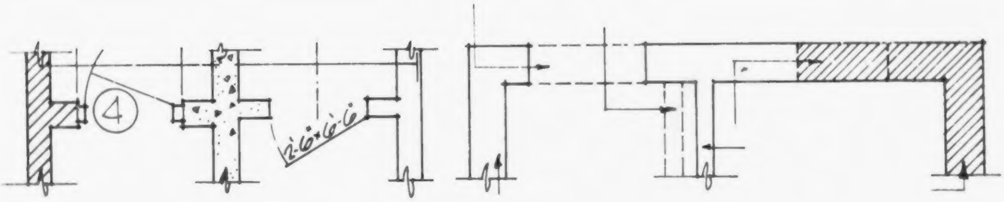


5)


STUD LINE
12'-0"
23'-0"
1'-0"
3" FUR
6"
9'-4"
6"
12'-9"
15'-2"
35'-0"



6)



TEST

9. State the purposes of written specifications.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

e. ____

____

10. List basic information included in a set of written specifications pertaining to concrete.

a. ____

b. ____

c. ____

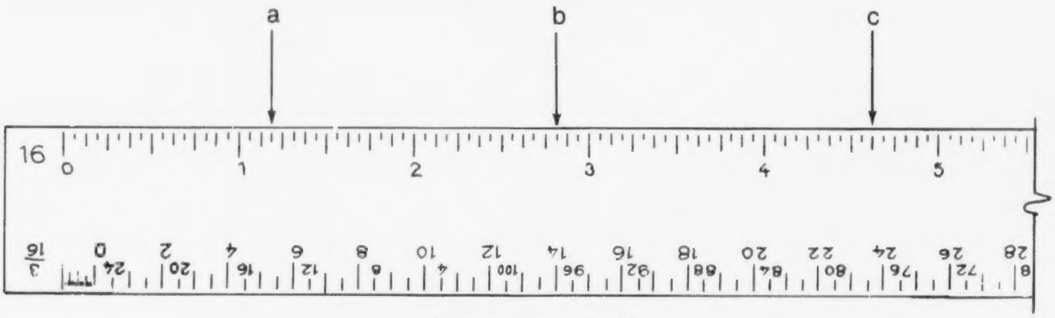
d. ____

e. ____

f. ____

g. ____

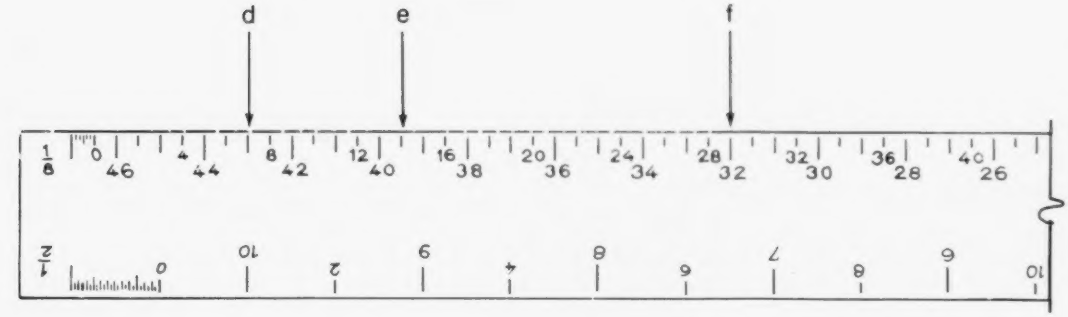
11. Read the measurements on the following architect's scales. Use the scales given, and write the correct answers in the corresponding blanks.


a
b
c
16
0
1
2
3
4
5
3/16
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28

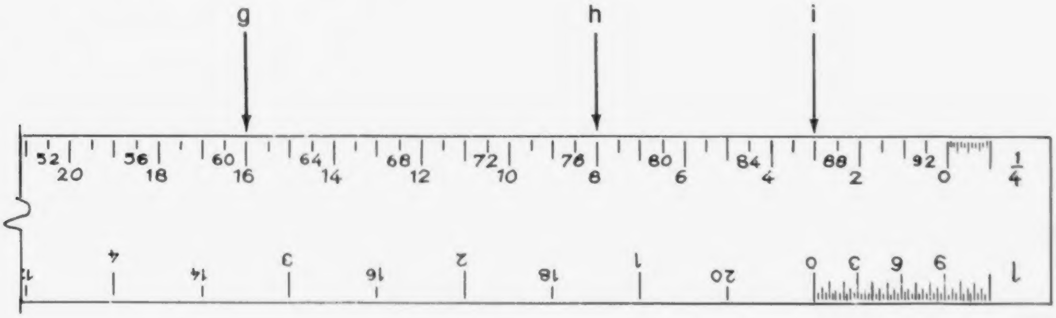
Scale — 1/16" = 1'-0"

a. ____________________ b. ____________________ c. ____________________

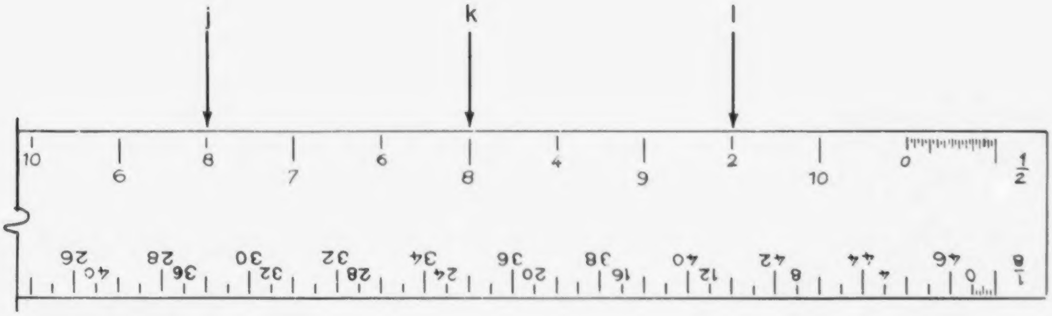
TEST


d
e
f
1/8
0
46
4
44
8
42
12
40
16
38
20
36
24
34
28
32
32
30
36
28
40
26
1/2
0
10
2
9
4
8
6
7
8
6
10

d. ____________ e. ____________ f. ____________

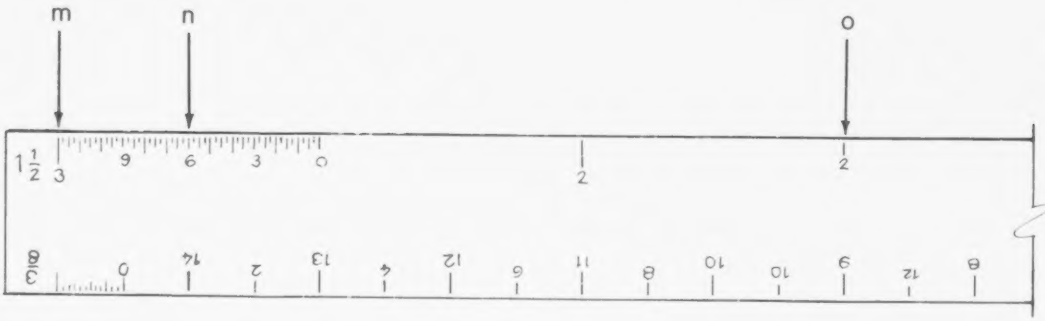

g
h
i
52
20
56
18
60
16
64
14
68
12
72
10
76
8
80
6
84
4
88
2
92
0
1/4
12
4
14
3
16
2
18
1
20
0
3
6
9
1

g. ____________ h. ____________ i. ____________

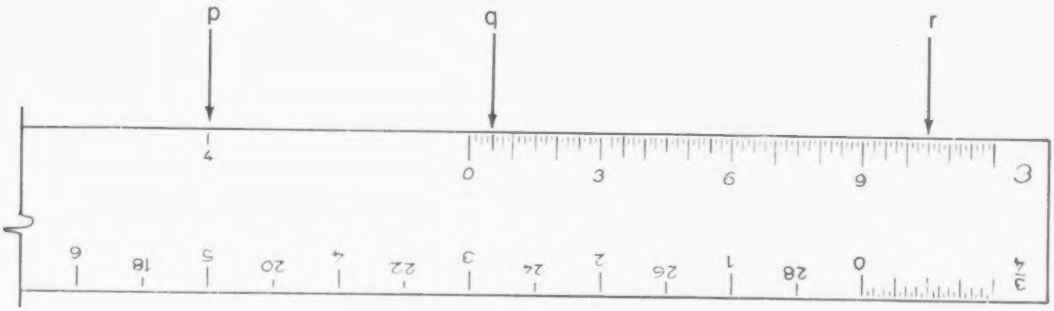

j
k
l
10
6
8
7
6
8
4
9
2
10
0
1/2
26
40
28
36
30
32
32
28
34
24
36
20
38
16
40
12
42
8
44
4
46
0
1/8

j. ____________ k. ____________ l. ____________

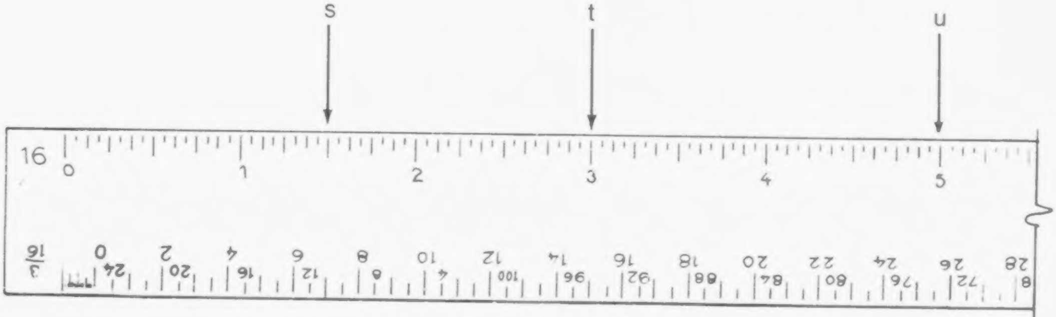
TEST



m. ____________ n. ____________ o. ____________



p. ____________ q. ____________ r. ____________



Scale — 12" = 1' -0"

s. ____________ t. ____________ u. ____________

TEST

(NOTE: Test items 12 through 14 list the assignment sheets that are considered an important part of this test. If they have not been completed, check with your instructor.)

12. Read plans.

13. Read details.

14. Read written specifications.

BASIC PLAN READING
UNIT III

ANSWERS TO TEST

1. a. 11
   b. 2
   c. 12
   d. 8
   e. 4
   f. 9
   g. 6
   h. 10
   i. 3
   j. 5
   k. 7
   l. 1
   m. 14
   n. 18
   o. 16
   p. 15
   q. 13
   r. 17

2. a. 3
   b. 1
   c. 5
   d. 4
   e. 6
   f. 2

3. a. Plot plan (Answer should include any four of the following.)

      1) Location, dimensions, and elevation of structure on site
      2) Finished and existing grade contours
      3) Property lines and dimensions
      4) Location of utilities
      5) Location of existing conditions
      6) Location and dimensions of driveways and walks

   b. Foundation plan (Answer should include the following.)

      1) Location and dimensions of footings, grade beams, foundation walls, stem walls, piers, equipment footings, and foundations
      2) Location of anchor bolts (in detail view)

   c. Floor plan (Answer should include any five of the following.)

      1) Outside walls, including location and dimensions of all exterior openings
      2) Types of construction materials
      3) Location of interior walls and partitions
      4) Location and swing of doors
      5) Stairways
      6) Location of windows

ANSWERS TO TEST

7) Location of cabinets, electrical and mechanical equipment, fixtures
8) Location of cutting-plane line

d. Elevation (Answer should include any four of the following.)

1) Grade lines
2) Floor height
3) Window and door types
4) Roof lines and slope, roofing material, vents, gravel stops, projection of eaves
5) Exterior finish materials and trim
6) Exterior dimensions

e. Section (Answer should include any three of the following.)

1) Details of construction and information about stairs, walls, chimneys, or other parts of construction that may not show clearly on plan
2) Floor levels in relation to grade
3) Wall thickness at various locations
4) Anchors and reinforcing steel

f. Detail (Answer should include any six of the following.)

1) Footings and foundations, including anchor bolts, reinforcing, control joints
2) Beams, floor joists, bridging, other support members
3) Sills, floor framing, exterior walls, vapor barriers
4) Floor heights, thickness, expansion, reinforcing
5) Interior walls
6) Windows, exterior and interior doors, door frames
7) Roof, cornice, soffit, ceilings
8) Gravel stops, fascia, flashing
9) Fireplaces, chimneys
10) Staircases, stair assembly
11) Millwork, trim, ornamental iron, specialty items

4.

a. 9	d. 2	g. 4
b. 1	e. 8	h. 5
c. 3	f. 7	i. 6

5.

__f__ Object line
__e__ Dimension line
__h__ Extension line
__b__ Hidden line
__c__ Center line
__d__ Cutting-plane line (section line)
__g__ Break line
__i__ Phantom line
__a__ Leader line

ANSWERS TO TEST

6. a. Glazed clay tile
   b. Brick veneer
   c. Common brick
   d. Concrete block
   e. Glass block
   f. Cut stone
   g. Board or quilt insulation
   h. Earth
   i. Gravel
   j. Concrete
   k. Reinforcing bars
   l. Gravel with sand
   m. Loose fill or batt insulation
   n. Plaster, sand, cement, or drywall
   o. Structural steel
   p. Waterproofing felt, flashing, etc.

7. a. Center to center
   b. Masonry opening
   c. Concrete block
   d. Center
   e. Expansion joint
   f. Terra cotta
   g. Bearing plate
   h. Full-scale detail
   i. Riser
   j. Reinforced concrete
   k. Angle
   l. Weep hole, on center
   m. Specifications
   n. Structural steel
   o. Benchmark

8. a. 2
   b. 4
   c. 5
   d. 3
   e. 1
   f. 6

9. a. Avoiding disputes among builders, architects, and owners by leaving no room for misinterpretation or misunderstanding

   b. Facilitating the checking of materials and workmanship during time that building is being constructed

   c. Enabling contractors to make bids based on total materials and labor required

   d. Avoiding expensive omissions when estimating total costs

   e. Avoiding conflicting opinions during construction and avoiding the added costs and delays that could result

10. a. Type and quality of material
    b. Sizes
    c. Method of construction
    d. Slump of concrete
    e. Concrete test
    f. Concrete finishes
    g. Tolerances

ANSWERS TO TEST

11. a. 19′ – 0″
    b. 45′ – 0″
    c. 74′ – 0″
    d. 7′ – 0″
    e. 14′ – 0″
    f. 29′ – 0″
    g. 16′ – 0″
    h. 8′ – 0″
    i. 3′ – 0″
    j. 8′ – 0″
    k. 5′ – 0″
    l. 2′ – 0″
    m. 1′ – 0″
    n. 6″
    o. 2′ – 0″
    p. 6″
    q. ½″
    r. 10 ½″
    s. 1 ½″
    t. 3″
    u. 5″

12. Evaluated to the satisfaction of the instructor

13. Evaluated to the satisfaction of the instructor

14. Evaluated to the satisfaction of the instructor

ESTIMATING
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to use various methods to estimate the cubic yards of concrete needed for a job. The student should also be able to estimate the number of rolls of welded wire fabric, the lineal feet of form lumber, and the number of form stakes needed for a job. The student will show this ability by completing the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with estimating.
2. List methods used to estimate cubic yards of concrete needed for a job.
3. Use a concrete calculator to estimate cubic yards of concrete needed for a job.
4. Use a concrete estimating table to estimate cubic yards of concrete needed for a job.
5. Use the formula for estimating cubic yards of concrete needed for a job.
6. List standard mesh and wire sizes of welded wire fabric.
7. State standard size of welded-wire-fabric rolls.
8. State standard square footage per roll of welded wire fabric.
9. Estimate rolls of welded wire fabric needed for a job.
10. Estimate lineal feet of form lumber needed for a job.
11. Estimate number of form stakes needed for a job.

ESTIMATING
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Transparency masters

      1. TM #1 — Concrete Calculator

      2. TM #2 — Concrete Estimating Table

      3. TM #3 — Electronic Calculator

      4. TM #4 — Standard Mesh and Wire Sizes of Welded Wire Fabric

   D. Information sheet

   E. Assignment Sheet #1 — Estimate Materials Needed for Concrete Jobs

   F. Answers to assignment sheet

   G. Test

   H. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials to supplement unit.

      1. Concrete calculators for each student

      2. Copies of concrete estimating tables for each student

      3. Furnish students with electronic calculators or have them provide their own if you wish them to use electronic calculators for problems in this unit.

      4. Transparencies and competency profiles

         (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, NW, Washington, D.C. 20006, phone 202-393-2040.)

SUGGESTED ACTIVITIES

C. Introduce unit to students by providing students with objective sheet and discussing unit and specific objectives.

SUGGESTIONS:

- Emphasize how important it is that concrete masons be able to estimate accurately so as not to have the extra expense of wasted materials.
- Stress how important it is to measure and record figures accurately when estimating.

D. Provide students with information and assignment sheets.

E. Discuss information and assignment sheets.

1. Use Information Sheet, Section I, to discuss terms associated with estimating.

   SUGGESTIONS:

   - Explain that while estimating with the methods described in this unit will give an approximate amount of the materials needed for a job, the amounts obtained will be accurate enough to get the job done without excess waste.
   - Use the chalkboard to illustrate the terms *cubic yard* and *lineal measurement*.
   - Discuss the definition of the term *formula*, and then have students look through the information sheet to find the formulas they will be using in this unit. Write these formulas on the chalkboard and discuss.

2. Use Information Sheet, Sections II through V, to discuss the different methods used to estimate the cubic yards of concrete needed for a job.

   SUGGESTIONS:

   - Hand out concrete calculators and explain how to use them. Use Transparency #1, "Concrete Calculator," to illustrate your explanation. Give students measurements and have them use concrete calculators to estimate the cubic yards of concrete needed for these measurements.
   - Hand out copies of Transparency #2, "Concrete Estimating Table." Explain the steps for using the table to estimate the cubic yards of concrete needed. Have students work in teams of two with one student giving measurements while the other uses the table to estimate the cubic yards needed for those measurements. Have students trade places.

SUGGESTED ACTIVITIES

- Explain the steps for using the formula for estimating cubic yards of concrete needed for a job. Show students how to convert inches to a fraction or a decimal portion of a foot, and then have students memorize formula.

- Show students how to use both the pencil-and-paper and electronic-calculator methods of figuring concrete estimates. Use Transparency #3, "Electronic Calculator," to illustrate your discussion.

- Have students complete Parts I through III of Assignment Sheet #1, "Estimate Materials Needed for Concrete Jobs." Have students figure their answers to the nearest hundredth where applicable.

3. Use Information Sheet, Sections VI through VIII, to discuss standard sizes of welded wire fabric.

   SUGGESTIONS:

   - Obtain samples of the various sizes of welded wire fabric or use Transparency #4, "Standard Mesh and Wire Sizes of Welded Wire Fabric," to illustrate your discussion.
   - Explain when the different sizes of welded wire fabric are used for concrete work.

4. Use Information Sheet, Section IX, to discuss estimating rolls of welded wire fabric needed for a job.

   SUGGESTIONS:

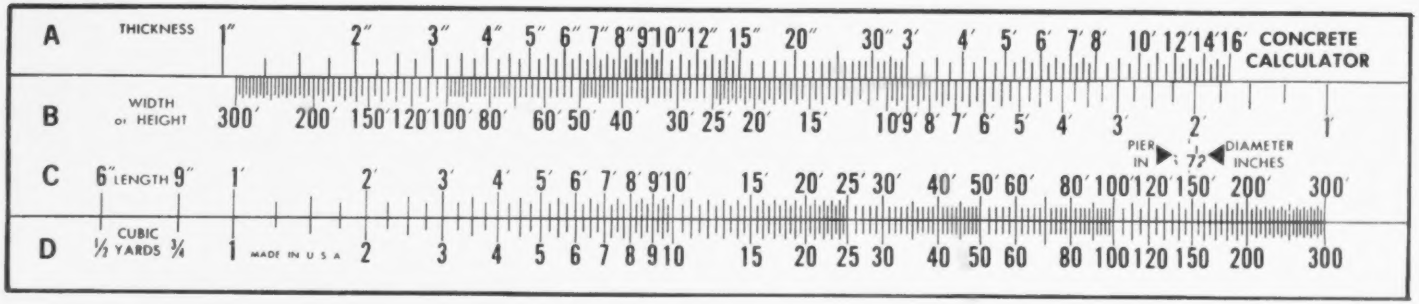
   - Explain that the number 675 in the formula is a constant representing the square feet of coverage in a standard 5′ × 150′ roll of welded wire fabric installed with a 6-inch overlay for each row. Draw a diagram on the chalkboard to illustrate how the welded wire fabric is overlayed.
   - Have students memorize the formula for estimating rolls of welded wire fabric needed for a job.
   - Have students complete Part IV of Assignment Sheet #1.

5. Use Information Sheet, Section X, to discuss estimating the lineal feet of form lumber needed for a job.

   SUGGESTIONS:

   - Explain that lumber is sold in even-foot measurements and that suppliers mix lengths to get as close as possible to the amount ordered unless specific sizes are ordered.
   - Review the definition of *lineal measurement* and discuss how easy it is to estimate the lineal feet of lumber required for forms—you simply add the perimeter measurements of the job.
   - Draw diagrams of jobs on the chalkboard and have students total the lineal feet of form lumber that would be required.

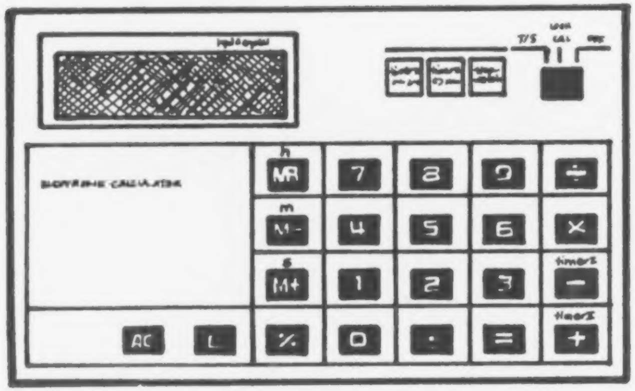
Concrete Calculator


A THICKNESS 1" 2" 3" 4" 5" 6" 7" 8" 9" 10" 12" 15" 20" 30" 3' 4' 5' 6' 7' 8' 10' 12' 14' 16'
CONCRETE CALCULATOR
B WIDTH or HEIGHT 300' 200' 150' 120' 100' 80' 60' 50' 40' 30' 25' 20' 15' 10' 9' 8' 7' 6' 5' 4' 3' 2' 1'
PIER IN ▶ 72 ◀ DIAMETER INCHES
C 6" LENGTH 9" 1' 2' 3' 4' 5' 6' 7' 8' 9' 10' 15' 20' 25' 30' 40' 50' 60' 80' 100' 120' 150' 200' 300'
D CUBIC ½ YARDS ¾ 1 MADE IN U S A 2 3 4 5 6 7 8 9 10 15 20 25 30 40 50 60 80 100 120 150 200 300

Concrete Estimating Table

One cubic yard of concrete will place					
Thickness	Sq ft	Thickness	Sq ft	Thickness	Sq ft
1"	324	5"	65	9"	36
1 1/4"	259	5 1/4"	62	9 1/4"	35
1 1/2"	216	5 1/2"	59	9 1/2"	34
1 3/4"	185	5 3/4"	56	9 3/4"	33
2"	162	6"	54	10"	32.5
2 1/4"	144	6 1/4"	52	10 1/4"	31.5
2 1/2"	130	6 1/2"	50	10 1/2"	31
2 3/4"	118	6 3/4"	48	10 3/4"	30
3"	108	7"	46	11"	29.5
3 1/4"	100	7 1/4"	45	11 1/4"	29
3 1/2"	93	7 1/2"	43	11 1/2"	28
3 3/4"	86	7 3/4"	42	11 3/4"	27.5
4"	81	8"	40	12"	27
4 1/4"	76	8 1/4"	39	15"	21.5
4 1/2"	72	8 1/2"	38	18"	18
4 3/4"	68	8 3/4"	37	24"	13.5

Electronic Calculator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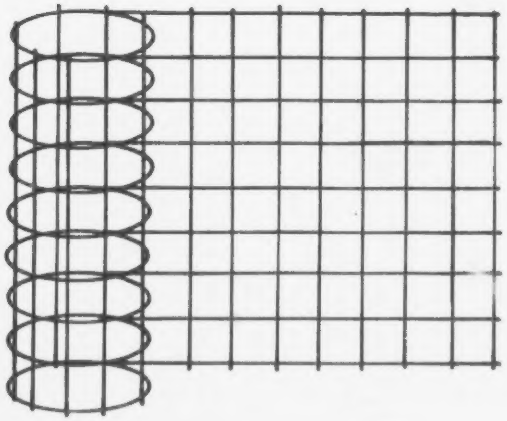
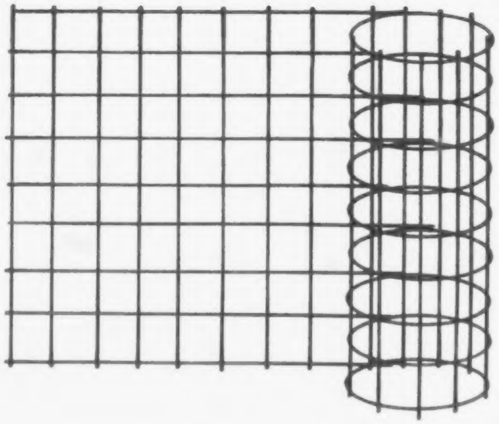
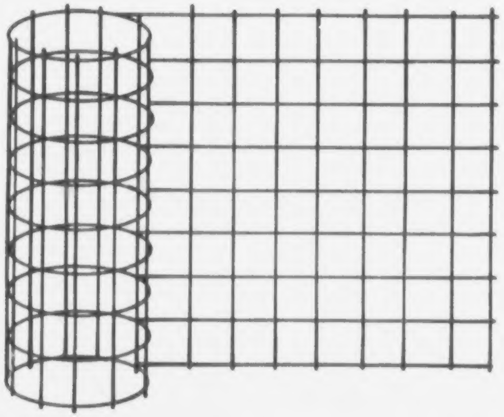
Standard Mesh and Wire Sizes of Welded Wire Fabric



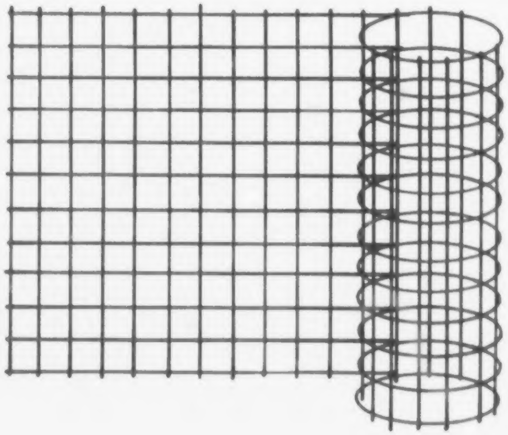
6″ × 6″ — W2.9 × W2.9



6″ × 6″ — W2.0 × W2.0



6″ × 6″ — W1.4 × W1.4



4″ × 4″ — W1.4 × W1.4

ESTIMATING
UNIT IV

INFORMATION SHEET

I. Terms and definitions associated with estimating

  A. Estimating — Determining the approximate amount of a substance or material needed for a job

  B. Cubic yard — 3′ × 3′ × 3′, or 27 cubic feet; unit of measure used for ordering concrete

  C. Lineal measurement — Unit of measure in a straight line

  D. Formula — Group of symbols used to express a mathematical concept

II. Methods used to estimate cubic yards of concrete needed for a job

  A. Concrete calculator

  B. Concrete estimating table

  C. Formula for estimating concrete

  (NOTE: Use the formula to estimate concrete when using pencil and paper or when using an electronic calculator.)

III. Steps for using a concrete calculator to estimate cubic yards of concrete needed for a job

  A. Locate required thickness on Scale A of concrete calculator

  B. Locate required width (or height) on Scale B of concrete calculator

  C. Move center portion of calculator to align required length on Scale A with required width (or height) on Scale B

  D. Locate required length on Scale C of concrete calculator

  E. Read number on Scale D that aligns with required length on Scale C to find the cubic yards of concrete needed for job

  EXAMPLE: If you are to pour a concrete slab that will be 4 inches thick by 40 feet wide by 40 feet long, then

    1. Locate 4-inch thickness on Scale A (See Figure 1)

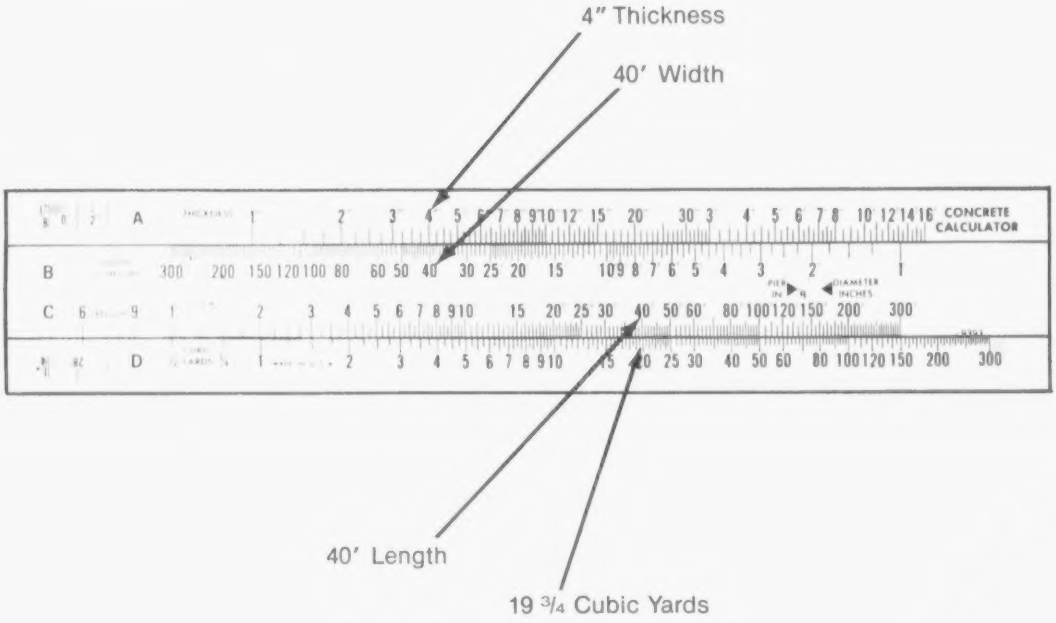
    2. Locate 40-feet width on Scale B (See Figure 1)

THE ASSOCIATED GENERAL CONTRACTORS OF AMERICA

INFORMATION SHEET

3. Move center portion of calculator to align 4-inch mark on Scale A with 40-feet mark on Scale B (See Figure 1)
4. Locate 40-feet length on Scale C (See Figure 1)
5. Read number on Scale D that aligns with 40-feet length mark to find cubic yards of concrete needed for job—19 3/4 cubic yards (Figure 1)

FIGURE 1



IV. Steps for using a concrete estimating table to estimate cubic yards of concrete needed for a job

A. Determine required area of job by multiplying length by width, using the formula

Area = Length × Width

EXAMPLE: If you are to pour a slab that will be 80 feet long by 40 feet wide by 4 inches thick, then

Area = 80′ × 40′ = 3200 Square Feet

B. Locate required thickness on thickness column of concrete estimating table (See Figure 2)

EXAMPLE: Locate 4 inches on thickness column of concrete estimating table.

FIGURE 2

81 Sq Ft

4" Thickness

One cubic yard of concrete will place					
Thickness	Sq ft	Thickness	Sq ft	Thickness	Sq ft
1"	324	5"	65	9"	36
1 1/4"	259	5 1/4"	62	9 1/4"	35
1 1/2"	216	5 1/2"	59	9 1/2"	34
1 3/4"	185	5 3/4"	56	9 3/4"	33
2"	162	6"	54	10"	32.5
2 1/4"	144	6 1/4"	52	10 1/4"	31.5
2 1/2"	130	6 1/2"	50	10 1/2"	31
2 3/4"	118	6 3/4"	48	10 3/4"	30
3"	108	7"	46	11"	29.5
3 1/4"	100	7 1/4"	45	11 1/4"	29
3 1/2"	93	7 1/2"	43	11 1/2"	28
3 3/4"	86	7 3/4"	42	11 3/4"	27.5
4"	81	8"	40	12"	27
4 1/4"	76	8 1/4"	39	15"	21.5
4 1/2"	72	8 1/2"	38	18"	18
4 3/4"	68	8 3/4"	37	24"	13.5

C. Read across table to determine square feet (area) 1 cubic yard of concrete will cover at required thickness (See Figure 2)

EXAMPLE: One cubic yard of concrete will cover 81 square feet at a 4-inch thickness.

D. Divide square-foot amount from table into number of square feet in job to find cubic yards of concrete needed for job, using the formula

$$\text{Cubic Yards of Concrete Needed for Job} = \frac{\text{Area of Job (Square Feet)}}{\text{Square-Foot Number from Estimating Table}}$$

EXAMPLE: If the area of the job is 3200 square feet and the square-foot number from the concrete estimating table is 81, then

$$\text{Cubic Yards of Concrete Needed for Job} = \frac{\text{3200 Square Feet}}{\text{81 Square Feet}} = 39{}^{1}/_{2}$$

INFORMATION SHEET

V. Steps for using the formula for estimating cubic yards of concrete needed for a job

A. Determine length and width and thickness of job

EXAMPLE: Assume you are to pour a concrete slab that will be 60 feet long by 30 feet wide by 3 inches thick.

B. If thickness of job is in inches, convert this amount to a fraction of a foot or a decimal portion of a foot

(NOTE: Thicknesses are usually quoted in inches.)

EXAMPLE: If the slab is to be 3 inches thick, convert 3 inches to $\frac{1}{4}$ foot, or .25 foot.

C. Determine cubic yards of concrete needed for job by multiplying length of job (in feet) by width of job (in feet) by thickness of job (in feet) and dividing product by 27, using the formula

$$\text{Cubic Yards of Concrete Needed for Job} = \frac{\text{Length in Ft} \times \text{Width in Ft} \times \text{Thickness in Ft}}{27}$$

EXAMPLE: If you are to pour a concrete slab that will be 60 feet long by 30 feet wide by 3 inches thick, then

$$\text{Cubic Yards of Concrete Needed for Job} = \frac{60' \times 30' \times .25'}{27} = \frac{450}{27} = 16.66$$

VI. Standard mesh and wire sizes of welded wire fabric

A. 6″ × 6″ mesh size—W2.9 × W2.9 wire size

B. 6″ × 6″ mesh size—W2.0 × W2.0 wire size

C. 6″ × 6″ mesh size—W1.4 × W1.4 wire size

D. 4″ × 4″ mesh size—W1.4 × W1.4 wire size

VII. Standard size of welded-wire-fabric rolls — 5′ × 150′

VIII. Standard square footage per roll of welded wire fabric — 750 square feet

IX. Steps for estimating rolls of welded wire fabric needed for a job

A. Determine area of job by multiplying length by width, using the formula

$$\text{Area} = \text{Length} \times \text{Width}$$

INFORMATION SHEET

EXAMPLE: If the job is to be 100 feet long by 50 feet wide, then

Area = 100′ × 50′ = 5000 Square Feet

B. Divide area of job by 675 to determine the number of rolls of welded wire fabric needed for job, using the formula

$$\begin{array}{c}\text{Rolls of Welded Wire Fabric}\\ \text{Needed for Job}\end{array} = \frac{\text{Area}}{675}$$

(NOTE: The number 675 is a constant representing the square feet of coverage in a standard 5′ × 150′ roll of welded wire fabric installed with a 6-inch overlay for each row.)

EXAMPLE: If the area of a job is 5000 square feet, then

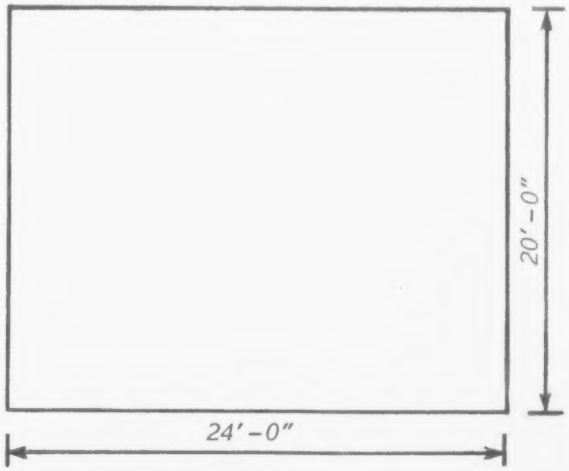
$$\begin{array}{c}\text{Rolls of Welded Wire Fabric}\\ \text{Needed for Job}\end{array} = \frac{\text{5000 Square Feet}}{675} = 7.40$$

X. Estimating lineal feet of form lumber needed for a job—Measure the distance in which the lumber will be used

(NOTE: Lumber is sold in even-foot measurements [6 feet, 8 feet, 10 feet, 12 feet]. Most suppliers mix lengths to get as close as possible to the amount ordered if each length is not specified. The buyer is charged for the amount delivered, not for the amount ordered.)

EXAMPLE: If you must estimate the lumber needed for the form to be built for the slab in Figure 3, you would measure the perimeter of the area and add these measurements to find that you would need to order 88 lineal feet of lumber.

FIGURE 3



INFORMATION SHEET

XI. Guidelines for estimating the number of form stakes needed for a job

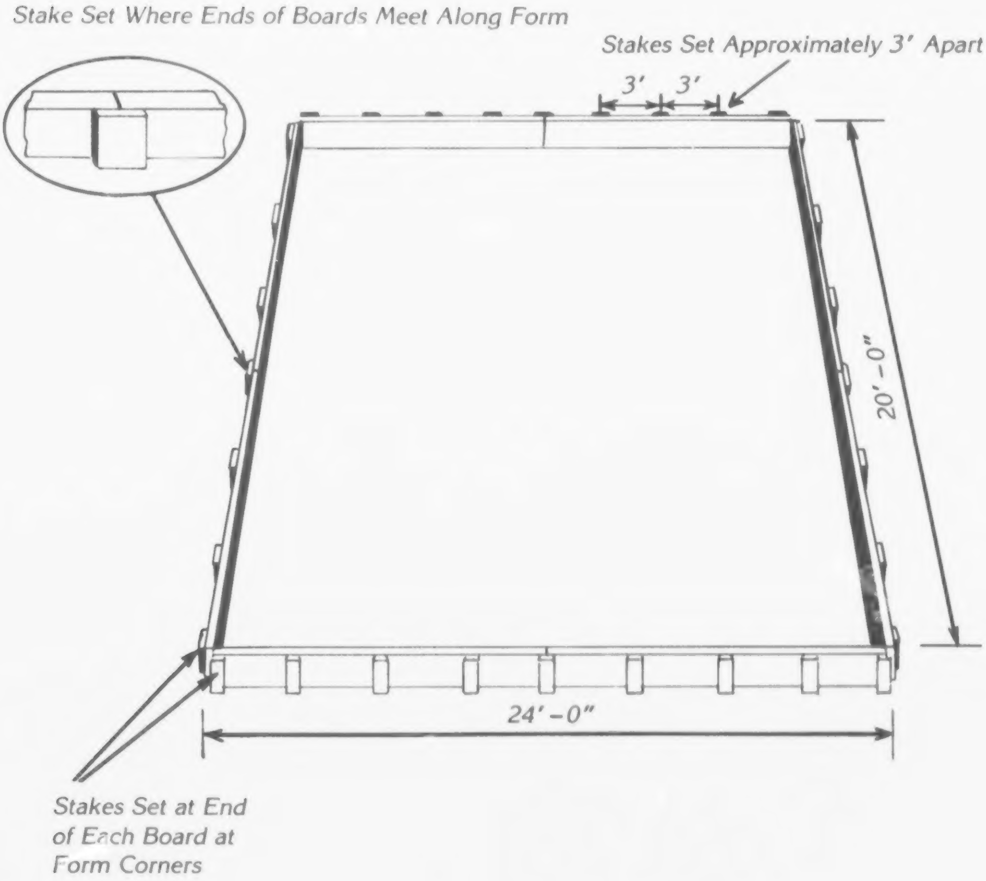
(NOTE: Some instructors estimate the number of stakes that will be needed to hold the ends of boards where they meet along the form. See Figure 4. If your instructor so requests, add this guideline to those given below.)

A. Stakes are set approximately 3 feet apart (See Figure 4)

B. Stakes are set at the end of each board at form corners (Figure 4)

EXAMPLE: Approximately thirty-two stakes will be needed for a form for a slab that will measure 24 feet long by 20 feet wide.

FIGURE 4



Stake Set Where Ends of Boards Meet Along Form
Stakes Set Approximately 3' Apart
3'
3'
20'-0"
24'-0"
Stakes Set at End of Each Board at Form Corners

ESTIMATING
UNIT IV

ASSIGNMENT SHEET #1 — ESTIMATE MATERIALS NEEDED FOR CONCRETE JOBS

NAME ______________________________ SCORE ______________

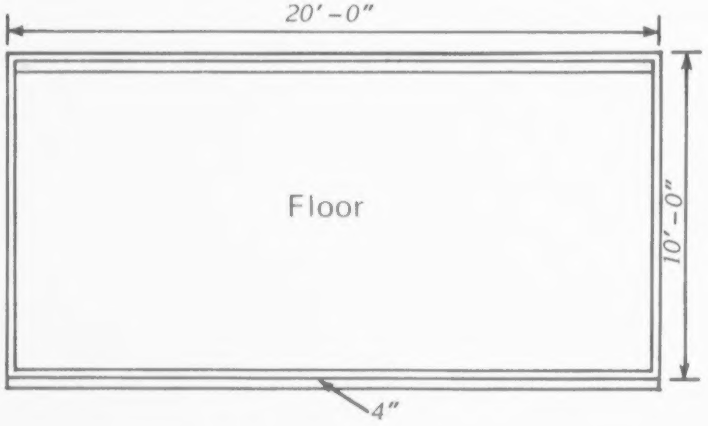
In order to write accurate orders for the concrete, welded wire fabric, form lumber, and form stakes needed for a job, a concrete mason must be skilled in using the methods of estimating. Practice using the various methods of estimating materials by completing this assignment sheet. Refer to Information Sheet, Sections III, IV, V, IX, X, and XI, as necessary.

PART I: Estimating cubic yards of concrete with a concrete calculator

Using the concrete calculator your instructor will supply, estimate the cubic yards of concrete that will be needed for each of the jobs described. Write your answers on the blanks provided.

A. How many cubic yards of concrete will be needed for the concrete floor in the drawing below?

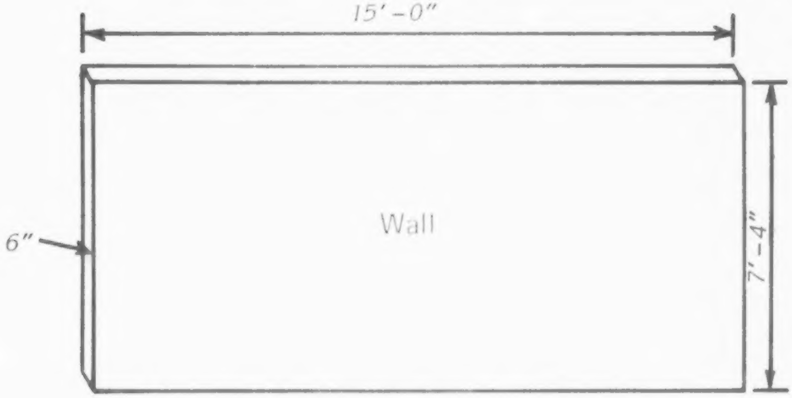
Cubic yards of concrete = ______________________________



B. How many cubic yards of concrete will be needed for the concrete wall in the drawing on the following page?

Cubic yards of concrete = ______________________________

ASSIGNMENT SHEET #1



PART II: Estimating cubic yards of concrete with an estimating table

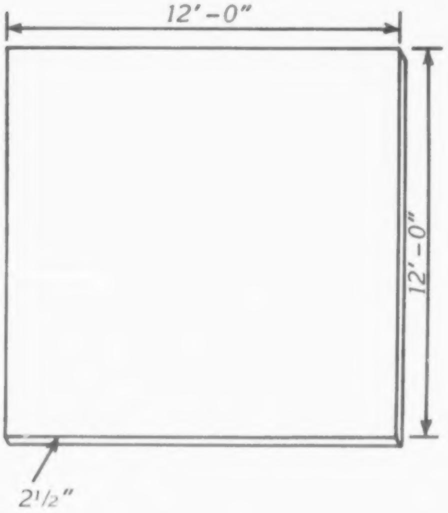
Using the concrete estimating table below, estimate the cubic yards of concrete that will be needed for each of the jobs described on the following page. Show your work in the spaces provided to the right of the drawings. Figure your answers to the nearest hundredth. Write your answers on the blanks provided.

One cubic yard of concrete will place					
Thickness	Sq ft	Thickness	Sq ft	Thickness	Sq ft
1″	324	5″	65	9″	36
1 1/4″	259	5 1/4″	62	9 1/4″	35
1 1/2″	216	5 1/2″	59	9 1/2″	34
1 3/4″	185	5 3/4″	56	9 3/4″	33
2″	162	6″	54	10″	32.5
2 1/4″	144	6 1/4″	52	10 1/4″	31.5
2 1/2″	130	6 1/2″	50	10 1/2″	31
2 3/4″	118	6 3/4″	48	10 3/4″	30
3″	108	7″	46	11″	29.5
3 1/4″	100	7 1/4″	45	11 1/4″	29
3 1/2″	93	7 1/2″	43	11 1/2″	28
3 3/4″	86	7 3/4″	42	11 3/4″	27.5
4″	81	8″	40	12″	27
4 1/4″	76	8 1/4″	39	15″	21.5
4 1/2″	72	8 1/2″	38	18″	18
4 3/4″	68	8 3/4″	37	24″	13.5

ASSIGNMENT SHEET #1

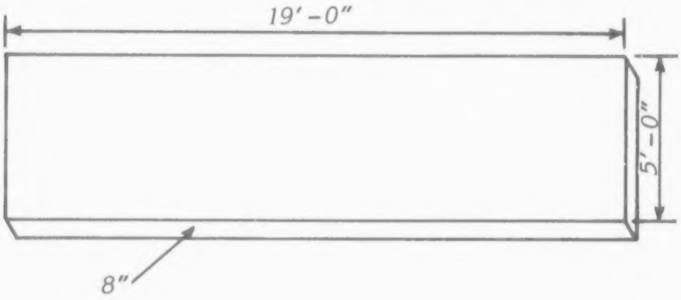
A. How many cubic yards of concrete will be needed for the concrete slab in the drawing below?

Cubic yards of concrete = ______________________________



B. How many cubic yards of concrete will be needed for the concrete slab in the drawing below?

Cubic yards of concrete = ______________________________



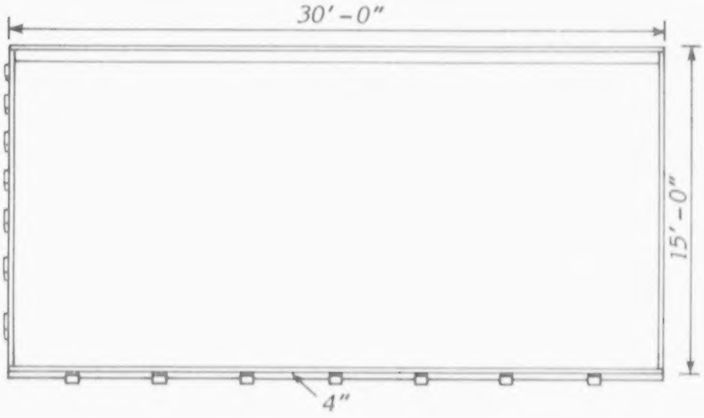
ASSIGNMENT SHEET #1

PART III: Estimating cubic yards of concrete with the concrete estimating formula

Using the concrete estimating formula, estimate the cubic yards of concrete that will be needed for each of the jobs described. Show your work in the spaces provided to the right of the drawings. Figure your answers to the nearest hundredth. Write your answers on the blanks provided.

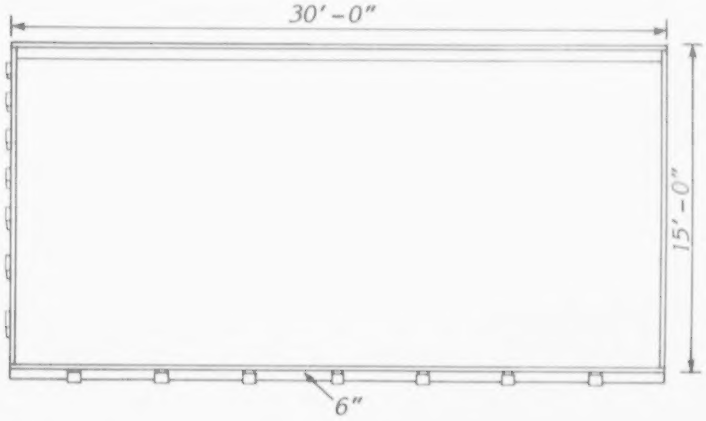
A. How many cubic yards of concrete will be needed for the concrete slab in the drawing below?

Cubic yards of concrete = ________________________________



B. How many cubic yards of concrete will be needed for the concrete slab in the drawing below?

Cubic yards of concrete = ________________________________

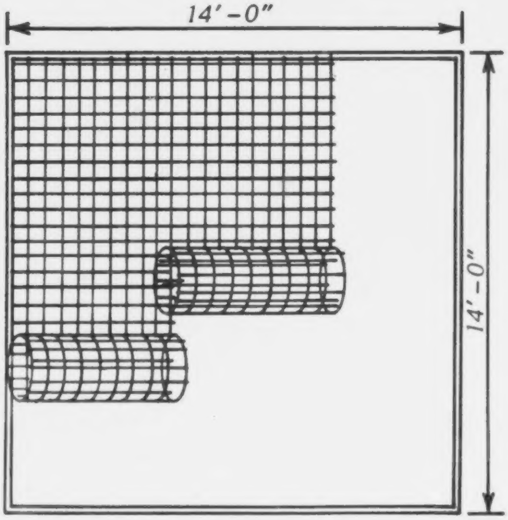


ASSIGNMENT SHEET #1

PART IV: Estimating the rolls of welded wire fabric needed for a job

Using the steps you learned in the information sheet, estimate the number of rolls of welded wire fabric that will be needed for the job described below. Show your work in the space provided to the right of the drawing. Figure your answer to the nearest hundredth. Write your answer on the blank provided.

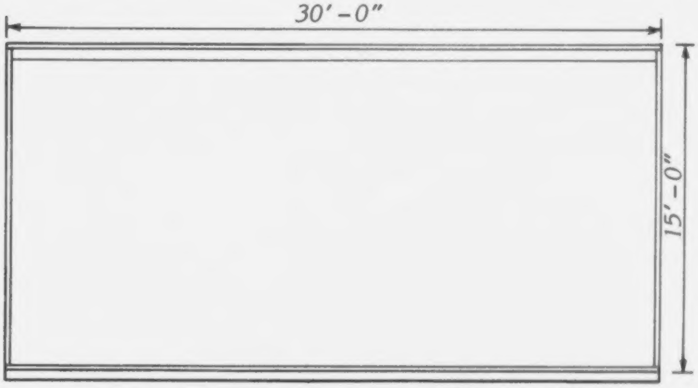
Rolls of welded wire fabric = ______________________________



PART V: Estimating the lineal feet of form lumber and the number of form stakes needed for a job

Using the guidelines you learned in the information sheet, estimate the lineal feet of form lumber and the number of form stakes needed for the job described below. Show your work in the space provided. Write your answers on the blanks provided.

Lineal feet of form lumber = ______________ Number of form stakes = ____________



ESTIMATING
UNIT IV

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

PART I

A. 2 1/2
B. 2

PART II

A. 1.10
B. 2.37

PART III

A. 5.55
B. 8.33

PART IV — .29 roll

PART V — 90 lineal feet of form lumber; approximately 34 stakes; however, answer may vary

ESTIMATING
UNIT IV

TEST

NAME ______________________________________ SCORE ________________

1. Match terms and definitions associated with estimating. Write the correct numbers in the blanks.

_____a. Unit of measure in a straight line

_____b. Determining the approximate amount of a substance or material needed for a job

_____c. 3′ × 3′ × 3′, or 27 cubic feet; unit of measure used when ordering concrete

_____d. Group of symbols used to express a mathematical concept

1. Estimating
2. Cubic yard
3. Lineal measurement
4. Formula

2. List methods used to estimate cubic yards of concrete needed for a job.

a. ____

b. ____

c. ____

3. Use a concrete calculator (supplied by your instructor) to estimate cubic yards of concrete needed for a concrete slab 200 feet long by 50 feet wide by 5 inches thick. Write your answer on the blank below.

Cubic yards of concrete = ______________________________

4. Use the concrete estimating table on the next page to estimate the cubic yards of concrete needed for a concrete slab 40 feet long by 20 feet wide by 6 inches thick. Show your work in the space provided, and write your answer on the blank below.

Cubic yards of concrete = ______________________________

TEST

Concrete estimating table

One cubic yard of concrete will place					
Thickness	Sq ft	Thickness	Sq ft	Thickness	Sq ft
1"	324	5"	65	9"	36
1 1/4"	259	5 1/4"	62	9 1/4"	35
1 1/2"	216	5 1/2"	59	9 1/2"	34
1 3/4"	185	5 3/4"	56	9 3/4"	33
2"	162	6"	54	10"	32.5
2 1/4"	144	6 1/4"	52	10 1/4"	31.5
2 1/2"	130	6 1/2"	50	10 1/2"	31
2 3/4"	118	6 3/4"	48	10 3/4"	30
3"	108	7"	46	11"	29.5
3 1/4"	100	7 1/4"	45	11 1/4"	29
3 1/2"	93	7 1/2"	43	11 1/2"	28
3 3/4"	86	7 3/4"	42	11 3/4"	27.5
4"	81	8"	40	12"	27
4 1/4"	76	8 1/4"	39	15"	21.5
4 1/2"	72	8 1/2"	38	18"	18
4 3/4"	68	8 3/4"	37	24"	13.5

5. Use the formula for estimating cubic yards of concrete to calculate the amount of concrete needed for a concrete slab 90 feet long by 30 feet wide by 3 inches thick. Show your work in the space provided, and write your answer on the blank below.

   Cubic yards of concrete = ____________________

6. List standard mesh and wire sizes of welded wire fabric.

   a. ____________________

   b. ____________________

   c. ____________________

   d. ____________________

TEST

7. State the standard size of welded-wire-fabric rolls. Write your answer on the blank below.

   Size of welded-wire-fabric rolls = ______________________________

8. State the standard square footage per roll of welded wire fabric. Write your answer on the blank below.

   Square footage per roll of welded wire fabric = ____________________

9. Estimate rolls of welded wire fabric needed for a concrete slab 150 feet long by 100 feet wide. Show your work in the space provided, and write your answer on the blank below.

   Rolls of welded wire fabric = ______________________________

10. Estimate lineal feet of form lumber needed for a concrete slab 25 feet long by 25 feet wide. Show your work in the space provided, and write your answer on the blank below.

    Lineal feet of form lumber = ______________________________

11. Estimate the number of form stakes needed for a concrete project that will be 150 feet long by 30 feet wide. Show your work in the space provided, and write your answer on the blank below.

    Number of form stakes = ______________________________

ESTIMATING
UNIT IV

ANSWERS TO TEST

1. a. 3 c. 2
   b. 1 d. 4

2. a. Concrete calculator
   b. Concrete estimating table
   c. Formula for estimating concrete

3. 154

4. 14.81

5. 25

6. a. 6″ × 6″ mesh size—W2.9 × W2.9 wire size
   b. 6″ × 6″ mesh size—W2.0 × W2.0 wire size
   c. 6″ × 6″ mesh size—W1.4 × W1.4 wire size
   d. 4″ × 4″ mesh size—W1.4 × W1.4 wire size

7. 5′ × 150′

8. 750 square feet

9. 22.22

10. 100

11. Evaluated to the satisfaction of the instructor; answer may vary depending on the material used.

CONCRETE INGREDIENTS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss the ingredients used in making good concrete and state the steps in producing good concrete. The student will show this ability by completing the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Select from a list correct definitions of terms associated with concrete ingredients.
2. State steps in producing good concrete.
3. Name the properties of cement suitable for use as an ingredient in concrete.
4. State properties of water suitable for use as an ingredient in concrete.
5. Briefly discuss the effects of using impure water as an ingredient in concrete.
6. State properties of aggregates suitable for use as an ingredient in concrete.
7. State categories of aggregate sizes and their definitions.
8. List classes of artificial aggregates and materials used in each class.

CONCRETE INGREDIENTS
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents
  A. Objective sheet
  B. Suggested activities
    1. Supplements
      a. Supplement #1 — Artificial Aggregates Used in Making Concrete
      b. Supplement #2 — Testing Aggregates for Quality
    2. Transparency masters
      a. TM #1 — Common Aggregates
      b. TM #2 — Cross Section of Good Concrete
      c. TM #3 — Well-Graded Aggregate
      d. TM #4 — Categories of Aggregate Sizes
      e. TM #5 — Sizing Aggregates
  C. Information sheet
  D. Test
  E. Answers to test

II. Instructor's guide
  A. Review unit and plan presentation.
  B. Obtain materials to supplement unit.
    1. Slides of projects where inferior concrete was used
    2. Cross-section sample of good concrete
    3. Cross-section samples of poor or inferior concrete
    4. Transparencies and competency profiles

(NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

SUGGESTED ACTIVITIES

C. Introduce unit.

SUGGESTIONS:

- Ask students whether or not they have ever seen projects where concrete of inferior quality was used. List qualities of inferior concrete on the chalkboard.

- Show students slides of projects where inferior concrete was used. Discuss the fact that inferior concrete ingredients can cause inferior concrete.

- Provide students with objective sheet and discuss unit and specific objectives, emphasizing the properties of quality concrete ingredients.

- Take students on a field trip to a concrete batch plant. Show students the sieves used at the plant to analyze aggregate size, the various methods used to test concrete ingredients, and the methods of mixing concrete ingredients.

D. Provide students with information sheet.

E. Discuss information sheet.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with concrete ingredients.

   SUGGESTIONS:

   - Review the definitions of *concrete* and *cement*. Emphasize that cement is an ingredient in concrete.

   - Review the safety rules for proper dress when working with concrete. See Unit V, "Safety and Basic First Aid." Stress that fresh concrete is highly alkaline and can cause skin irritation, eye infection, and severe skin burns.

   - Discuss the term *aggregate*, using Transparency #1, "Common Aggregates," to illustrate the most common aggregates. Emphasize the economic reasons for using filler material to provide volume by stating that aggregates account for 60 to 80 percent of the volume of concrete.

2. Use Information Sheet, Section II, to disucss the steps in producing good concrete.

   SUGGESTIONS:

   - Have students list the concrete ingredients they saw being mixed at the concrete batch plant. Then discuss how these ingredients produce concrete: Cement and water form a paste that surrounds the aggregate and through the chemical reaction of hydration bind the aggregate to produce concrete. Use a cross-section sample of good concrete or Transparency #2 to illustrate your discussion.

SUGGESTED ACTIVITIES

- Show cross-section samples of poor concrete, pointing out the voids between the aggregate samples.

3. Use Information Sheet, Section III, to discuss the properties of cement suitable for use as an ingredient in concrete.

   SUGGESTIONS:

   - Explain to students that cement is often sold in bulk and then stored for periods of time, and that sometimes during storage, the cement may become lumpy. These lumps may be caused from exposure to moisture or from compaction. Lumps caused from exposure to moisture make the cement unsuitable as an ingredient in concrete, but lumps caused by compaction, called "warehouse pack," do not affect the quality of the cement or the concrete.

   - Demonstrate the test for determining whether or not the lumps found in cement make it unsuitable for use as an ingredient in concrete. Hold a lump of cement between your thumb and forefinger and then press your fingers together. If the lump cannot be pulverized, it was probably caused by water absorption and the cement should not be used. If the lump is easily pulverized, it was probably caused by compaction and the cement can be used.

4. Use Information Sheet, Sections IV and V, to discuss the properties of water suitable for use as an ingredient in concrete and the effects of using impure water as an ingredient in concrete.

   SUGGESTIONS:

   - Explain the general rule of thumb that drinkable water with no pronounced taste or odor is probably free from impurities and therefore suitable as an ingredient in concrete.

   - Emphasize that using water with excessive impurities affects concrete's setting time and strength, stains concrete, and corrodes reinforcing material. To prevent these undesirable effects, it is best to use water that has been analyzed. However, if unanalyzed water must be used, it is a good practice to make concrete strength tests to determine the suitability of the water.

   - Discuss or demonstrate the strength tests used to determine the suitability of mixing water.

5. Use Information Sheet, Sections VI through VIII, to discuss properties of aggregates suitable for use as an ingredient in concrete, aggregate sizes, and artificial aggregates.

   SUGGESTIONS:

   - Explain that the natural aggregates sand, gravel, and crushed stone are most commonly used in producing concrete, where they serve as filler material that is bound together by the cement-and-water paste.

SUGGESTED ACTIVITIES

Further explain that most aggregates are classified by size as being *fine* or *coarse* and that good concrete contains a well-graded mixture of both fine aggregate (sand) and coarse aggregate (gravel or crushed stone). However, because supplies of natural aggregates are running low and because of new building requirements, artificial aggregates are now being used in making concrete. Use Transparencies #3 through #5 and Supplement #1, "Artificial Aggregates Used in Making Concrete," to illustrate your discussion.

- Show the sieves used for grading aggregates: fine aggregates are graded with sieves ranging from a #100 to #4 screen size; coarse aggregates are graded with seives ranging from #4 to a 6-inch screen size.
- Emphasize that whatever the aggregate used, it must be well-graded, clean and free from impurities, abrasion-resistant, freeze/thaw-resistant, cuboid-shaped, durable, and hard. If an aggregate is not cuboid in shape, the cement paste will be more expensive to produce. If an aggregate is not well-graded and contains impurities such as dust, silt, loam, clay, or vegetable matter, the setting time may be affected and the cement paste will not bind properly. If an aggregate is not abrasion-resistant, hard, and durable, the hardened concrete will not be as strong and will wear or weather rapidly.
- Show samples of poor concrete containing poorly graded, flaky, weak, friable, or shale-laminated aggregate particles.
- Use Supplement #2, "Testing Aggregates for Quality," to demonstrate the testing procedures for aggregates of unknown quality. You may have students do the silt test, or you may conduct the demonstration yourself. However, you may not want students to conduct the colorimetric test, since a potentially harmful substance, sodium hydroxide, is used in the test.

F. Give test.

G. Critique test and discuss in class.

H. Complete appropriate sections of competency profiles.

III. Unit references

A. *Cement and Concrete Terminology*, ACI 116 R-85 Publication SP-19(85). Detroit, Michigan: American Concrete Institute, 1985.

B. *Concrete Information*. Skokie, Illinois: Portland Cement Association, 1966.

C. *Concrete Technology*. Skokie, Illinois: Portland Cement Association, 1965.

D. Hendrix, Laborn J. "Bud". *Cement Masonry Curriculum*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1975.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — ARTIFICIAL AGGREGATES USED IN MAKING CONCRETE

Normally, sand, gravel, and crushed stone are used as aggregates to make concrete. However, new artificial aggregate materials are being developed today because supplies of natural sands and gravels are running low and because of the weight requirement needed to meet new applications for concrete as a building material. The following is a listing of these artificial aggregates and their uses.

Classes of artificial aggregates

Class	Unit weight per cubic foot	Aggregates used	Uses
Ultra-lightweight	4 to 30 pounds	Vermiculite Expanded glass Ceramic spheres Carbonized cereals Expanded plastics Perlite	Used for making lightweight concretes that can be sawed or nailed; also used for its insulating properties
Lightweight	40 to 70 pounds	Expanded clay Expanded shale Expanded slate Sintered fly ash Expanded slag Furnace clinker Crushed brick Petroleum coke	Used primarily for making concretes that will reduce the dead load of structures; also used for its insulating propertites
Normal-weight	70 to 110 pounds	Iron slag Glass frits Calcined bauxite Compacted cement	Used for normal concrete projects
Heavyweight	Excess of 120 pounds	Steel or iron shot Steel or iron pellets Steel or iron punchings	Used for making high-density concretes for shielding against nuclear radiation

SUGGESTED ACTIVITIES

SUPPLEMENT #2 — TESTING AGGREGATES FOR QUALITY

Aggregates suitable for use as an ingredient in concrete must be well-graded, clean, and free from impurities such as fine dust, silt, loam, clay, or vegetable matter. If not well-graded and clean, the cement paste will not properly bind the aggregate particles together, thus reducing the strength of the concrete. Two simple tests can be given to determine aggregate quality in two areas: (1) the silt test, used to detect the presence of extremely fine materials in an aggregate and (2) the colorimetric test, used to detect the presence of harmful amounts of vegetable matter in an aggregate.

Using the following procedures for the silt test and the colorimetric test, determine the quality of aggregate samples.

Silt Test

Equipment and materials

1-quart fruit jar and lid for each aggregate sample

Dry aggregate (sand)

Water

Ruler or tape

Chart for recording test results

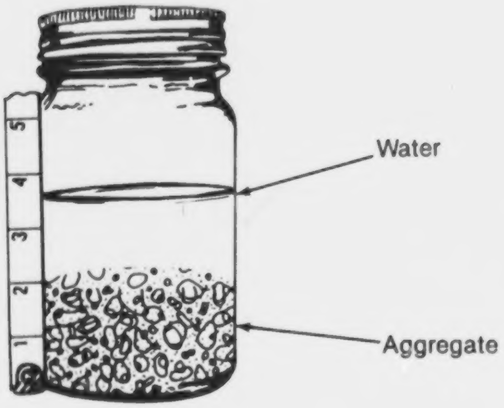
Pencil

Procedure for each sample

A. Pour aggregate into fruit jar to a depth of 2 inches (See Figure A)

B. Add water until jar is about three-fourths full (Figure A)

FIGURE A



SUPPLEMENT #2

C. Cover jar opening with lid and shake jar vigorously for one minute, using an up-and-down motion

D. Shake jar, using a side-to-side motion, until aggregate is level in jar

E. Allow jar to stand undisturbed for one hour

(NOTE: During this time, silt will be deposited in a layer above the sand.)

F. Measure silt layer in fruit jar and record measurement on chart

G. Determine quality of aggregate, using the following guideline: If silt layer is more than $^1/_8$ inch deep, aggregate is not satisfactory for concrete work unless excess silt is removed

Colorimetric Test

Equipment and materials

12-ounce prescription bottle and rubber stopper for each aggregate sample

Dry aggregate samples (sand)

Caustic-soda solution (1 ounce sodium hydroxide and 1 quart distilled water)

(NOTE: Sodium hydroxide can be purchased at a drug store.)

Glass bottle with rubber stopper for storing caustic-soda solution

Chart for recording test results

Pencil

Rubber gloves

Procedure

A. Mix caustic-soda solution and store in glass bottle tightly closed with a rubber stopper

CAUTION

Never handle sodium hydroxide with moist hands. Serious burns may result. Wear rubber gloves.

B. Pour aggregate into bottle to the 4 $^1/_2$-ounce mark

C. Pour caustic-soda solution over the aggregate to the 7-ounce mark; put stopper in bottle and thoroughly shake contents

CAUTION

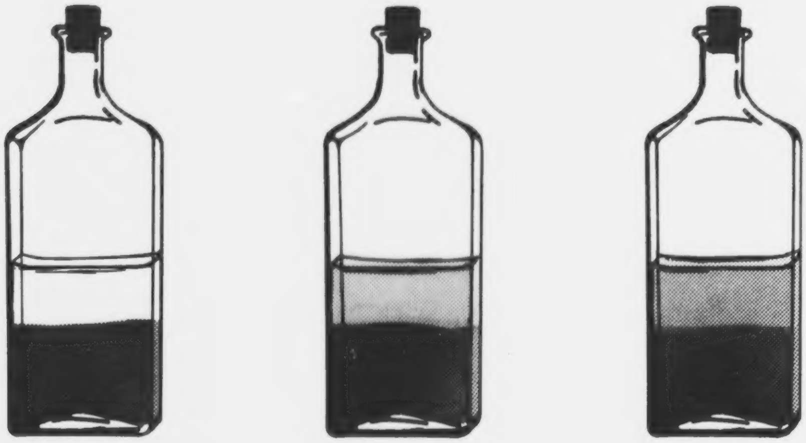
Handle caustic-soda solution carefully; it can seriously burn the skin and is highly injurious to clothing, leather, and many other materials.

SUPPLEMENT #2

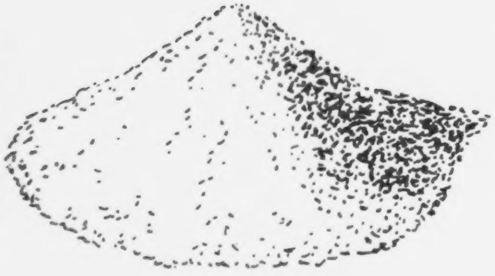
D. Allow bottle to stand undisturbed for twenty-four hours

E. Record test results and determine quality of aggregate, using the following guidelines: Colorless solution indicates aggregate is free of vegetable matter; straw-colored solution indicates some vegetable matter in aggregate, but not enough to make aggregate unsatisfactory for concrete work; bright yellow to medium brown solution indicates the aggregate contains unsatisfactory amounts of organic matter and should not be used for concrete work unless washed and tested again (Figure B)

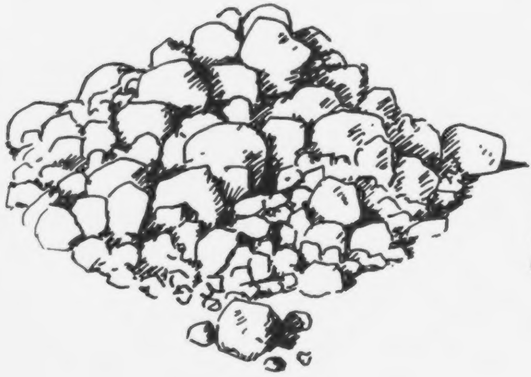
FIGURE B



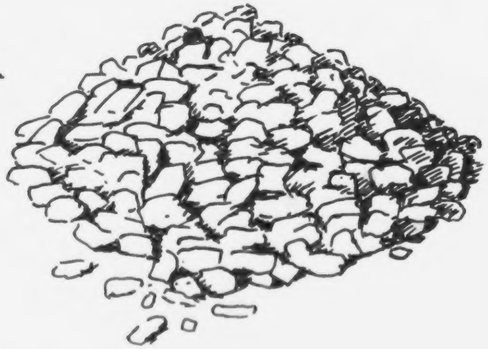
Common Aggregates



Sand

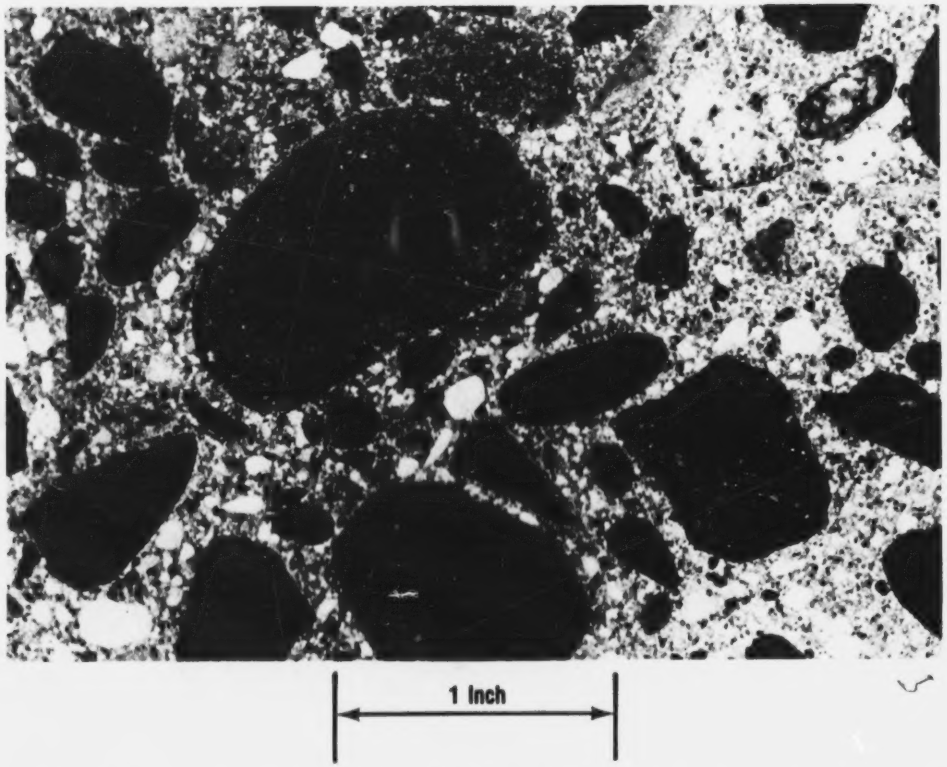


Gravel



Crushed Stone

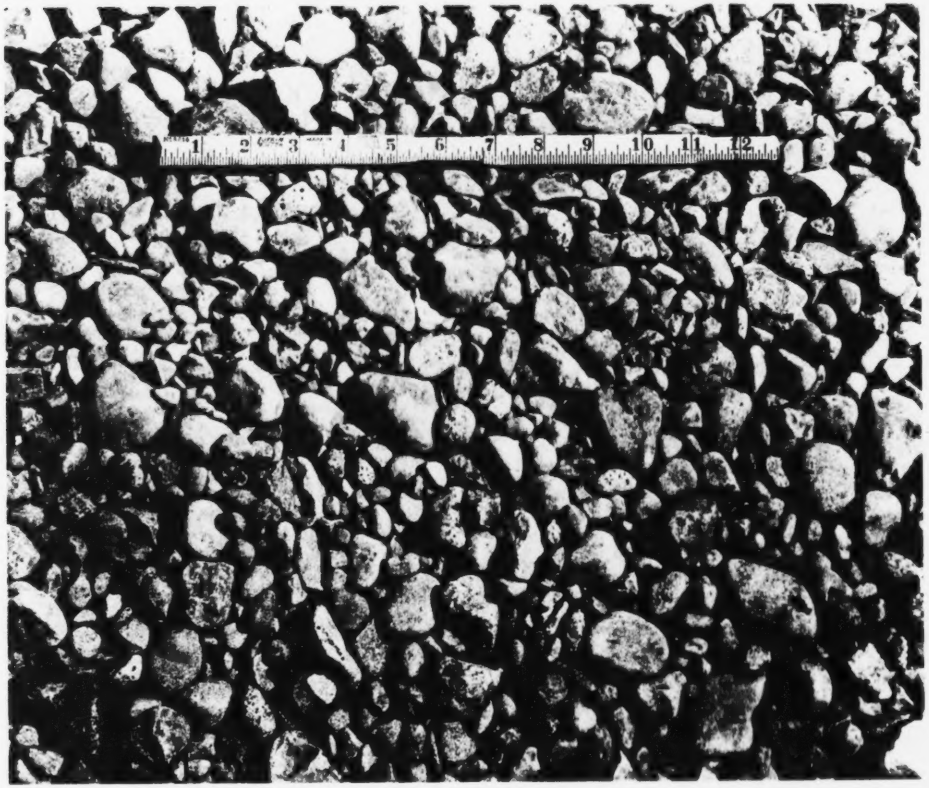
Cross Section of Good Concrete



Cement-and-water paste completely coats each aggregate particle and fills all the space between aggregate particles.

Courtesy of Portland Cement Association.

Well-Graded Aggregate

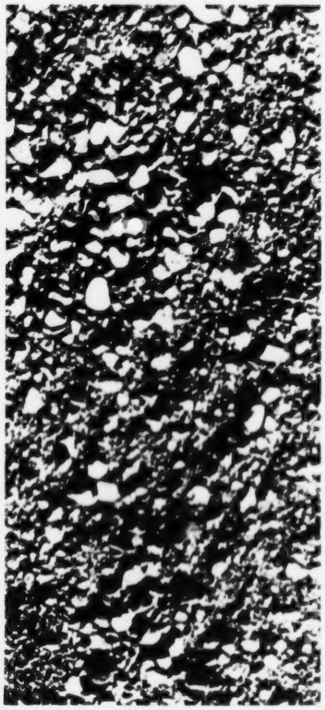


Courtesy of Portland Cement Association

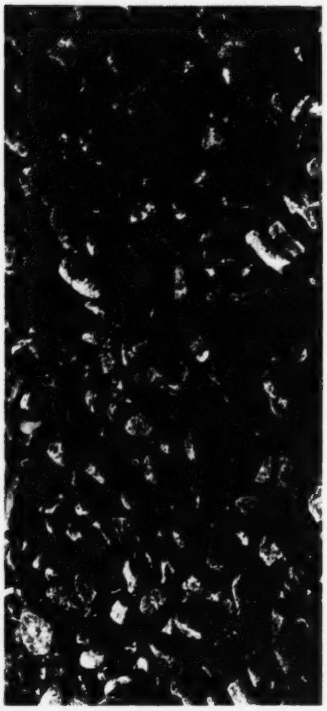
TM #3

FCCM - 17-C

Categories of Aggregate Sizes



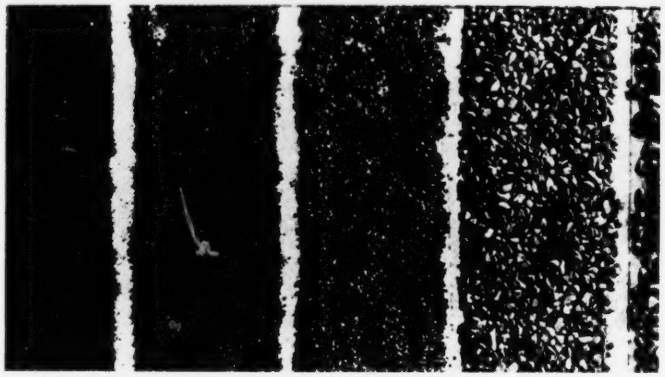
Fine



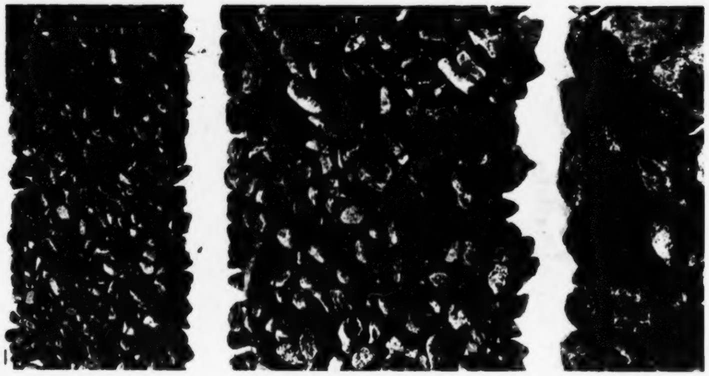
Coarse

Courtesy of Portland Cement Association.

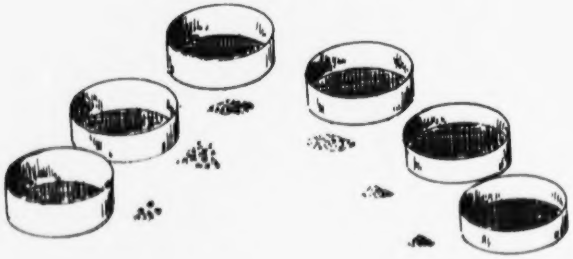
Sizing Aggregates



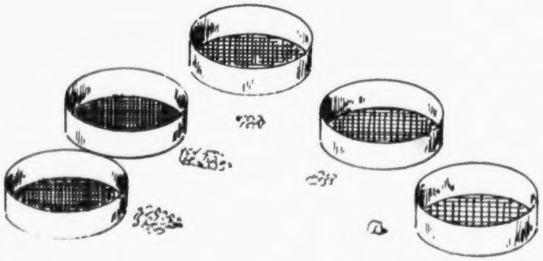
Fine



Coarse



Sieves for Analyzing Fine Aggregate



Sieves for Analyzing Coarse Aggregate

Courtesy of Portland Cement Association.

TM #5

FCCM - 21-C

CONCRETE INGREDIENTS
UNIT I

INFORMATION SHEET

I. Terms and definitions associated with concrete ingredients

A. Concrete — Building material made by mixing cement, water, and aggregates

(NOTE: Fresh concrete is highly alkaline [caustic] and can cause skin irritation, eye infection, and in some cases severe skin burns. Always wear protective clothing and follow strict safety precautions when working with fresh concrete.)

B. Cement — Powder made from alumina, silica, lime, iron oxide, and magnesia burned together in a kiln and finely pulverized; an ingredient in concrete

C. Aggregate — Filler material used in concrete to provide volume at low cost

(NOTE: Aggregates make up about 60 to 80 percent of the volume of concrete. Sand, gravel, and crushed stone are the most commonly used aggregates.)

D. Bind — To cause to stick together

E. Setting time — Time required for concrete to become firm or solid

F. Cuboid — Approximately cube-shaped

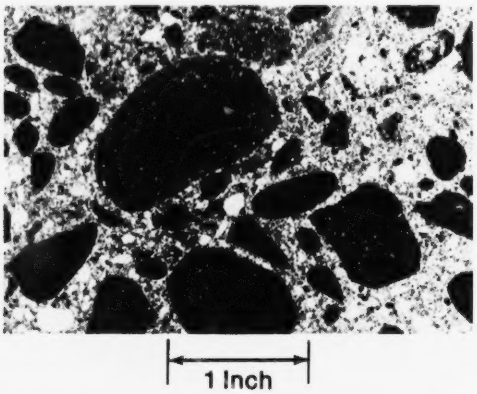
II. Steps in producing good concrete

A. Concrete ingredients (cement, water, and aggregates) are combined in proper proportions and mixed

B. Cement and water form a paste that completely surrounds every piece of aggregate and fills all the space between aggregate particles (Figure 1)

EXAMPLE: Cross section of good concrete

FIGURE 1



Courtesy of Portland Cement Association.

C. Chemical reaction between cement and water (hydration) occurs and binds the aggregate into a strong, durable, solid mass

III. Properties of cement suitable for use as an ingredient in concrete

A. Dry and free-flowing

(NOTE: Cement will retain its cementing quality indefinitely if it does not come into contact with moisture.)

B. Free of lumps

(NOTE: If the cement has been exposed to moisture and contains lumps that cannot be pulverized when pressed between your thumb and forefinger, do not use it as an ingredient in concrete.)

IV. Properties of water suitable for use as an ingredient in concrete

(NOTE: Generally, water that is fit to drink is suitable for making concrete.)

A. Tasteless and odorless

B. Clean and free of impurities

EXAMPLES: Salts, minerals, industrial wastes, algae

(NOTE: Water departments will usually provide an analysis of local water. However, when water that has not been analyzed and may contain unknown impurities is considered for use, particularly on large jobs, it is a good practice to make a concrete strength test.)

V. Effects of using impure water as an ingredient in concrete

A. Reduces cement's bonding ability

B. Affects concrete's setting time

(NOTE: Some impurities retard concrete's setting time, while some accelerate the setting time.)

C. Stains concrete

D. Corrodes steel used as reinforcing material

VI. Properties of aggregates suitable for use as an ingredient in concrete

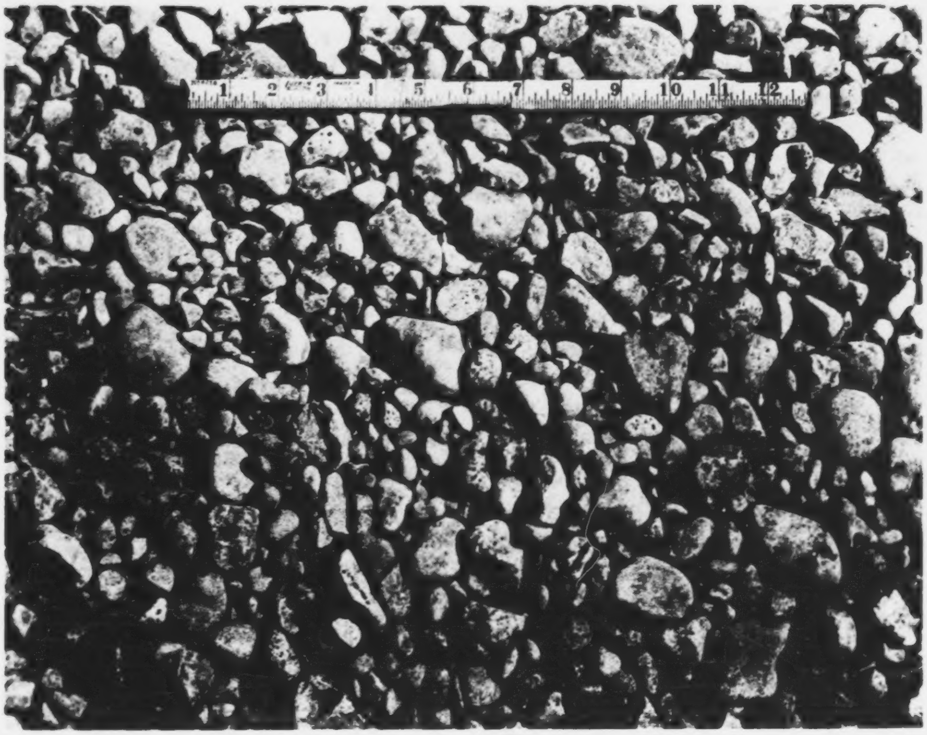
A. Well-graded

(NOTE: A well-graded aggregate consists of a mixture of both coarse and fine aggregate particles combined so that the smaller particles fit among the larger ones. See Figure 2. This type of mixture produces a more economical concrete since it requires less cement paste to create a bond than would otherwise be necessary to produce a given quality of concrete.)

INFORMATION SHEET

EXAMPLE: Well-graded aggregate

FIGURE 2



Courtesy of Portland Cement Association.

B. Clean and free from fine dust, silt, loam, clay, or vegetable matter

(NOTE: The impurities listed prevent the cement paste from properly binding the aggregate particles together.)

C. Abrasion-resistant

(NOTE: Abrasion resistance is essential when the aggregate is used in concrete surfaces such as floors and walls that are subject to abrasion.)

D. Freeze/thaw-resistant

(NOTE: If the particles of aggregate used in concrete are not freeze/thaw-resistant, they will weaken the strength of the concrete.)

INFORMATION SHEET

E. Approximately cuboid-shaped

(NOTE: Particles with flat, elongated shapes require more cement paste to produce workable concrete and are therefore more expensive to use than cube-shaped particles. However, the shape of the aggregate does not affect the strength of the concrete.)

F. Hard and durable

(NOTE: Aggregates that are soft, flaky, and wear rapidly when exposed to weather weaken the strength of the concrete.)

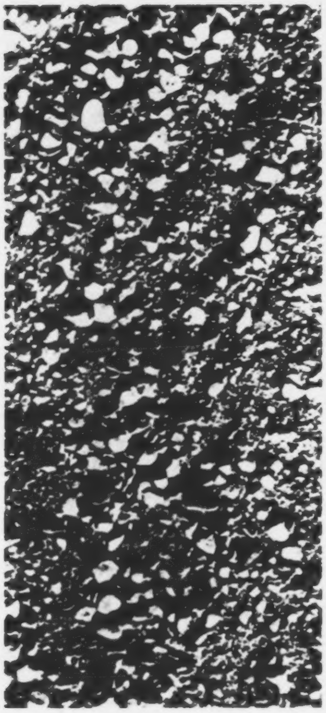
VII. Categories of aggregate sizes and their definitions

(NOTE: Aggregate sizes are determined by sieve analysis.)

A. Fine — Aggregate containing particles ranging in size from very fine up to ¼ inch (Figure 3)

EXAMPLE: Fine aggregate

FIGURE 3



Courtesy of Portland Cement Association.

INFORMATION SHEET

B. Coarse — Aggregate containing particles ranging in size from 1/4 inch up to the largest size that can be used on a job (See Figure 4)

(NOTE: The most common coarse-aggregate sizes are 3/8, 1/2, 3/4, 1, 1 1/2, and 2 inch. However, to determine the largest aggregate size that can be used on a job, use the following guidelines: [1] Aggregate should not exceed one-fifth the dimension of nonreinforced members. [2] Aggregate should not exceed three-fourths the clear spacing between reinforcing bars or between reinforcing bars and forms. [3] Aggregate should not exceed one-third the depth of nonreinforced slabs on grade.)

EXAMPLE: Coarse aggregate

FIGURE 4

Courtesy of Portland Cement Association.

VIII. Classes of artificial aggregates and materials used in each class

(NOTE: Normally sand, gravel, and crushed stone are used as aggregates to make concrete. However, new artificial aggregate materials are being developed because supplies of natural sands and gravels are running low and because of the weight requirements needed to meet new applications for concrete as a building material. The following is a list of these artificial aggregates.)

INFORMATION SHEET

A. Ultra-lightweight — Vermiculite, expanded glass, ceramic spheres, carbonized cereals, expanded plastics, perlite

(NOTE: Ultra-lightweight aggregates weigh from 4 to 30 pounds per cubic foot. They are used for making light concretes that can be sawed or nailed or used for their insulating properties.)

B. Lightweight — Expanded clay, expanded shale, expanded slate, sintered fly ash, expanded slag, furnace clinker, crushed brick, petroleum coke

(NOTE: Lightweight aggregates weigh from 40 to 70 pounds per cubic foot. They are used primarily for making light concretes that reduce the dead load of structures or light concretes used for their insulating properties.)

C. Normal-weight — Iron slag, glass frits, calcined bauxite, compacted cement

(NOTE: Normal-weight aggregates weigh from 70 to 110 pounds per cubic foot. They are used for ordinary concrete construction projects.)

D. Heavyweight — Steel or iron shot, steel or iron pellets, steel or iron punchings

(NOTE: Heavyweight aggregates weigh in excess of 120 pounds per cubic foot. They are used for making high-density concretes for shielding against nuclear radiation.)

CONCRETE INGREDIENTS
UNIT I

TEST

NAME ____ SCORE ________________

1. Select from a list correct definitions for terms associated with concrete ingredients. Read each term below and write an "X" beside the definition that best defines that term.

a. **Concrete**

______1) Powder made from alumina, silica, lime, iron oxide, and magnesia burned together in a kiln and finely pulverized

______2) Building material made by mixing cement, water, and aggregates

______3) Type of finely ground cement

b. **Cement**

______1) Powder made from alumina, silica, lime, iron oxide, and magnesia burned together in a kiln and finely pulverized

______2) Building material made by mixing cement, water, and aggregates

______3) Filler material used in concrete to provide volume at low cost

c. **Aggregate**

______1) To cause to stick together

______2) Type of finely ground cement

______3) Filler material used in concrete to provide volume at low cost

d. **Bind**

______1) To cause to stick together

______2) To provide volume at low cost

______3) To cause cement powder to settle

e. **Setting time**

______1) Time required for cement powder to settle

______2) Time required for concrete to become firm or solid

______3) Time required for concrete to become approximately cube-shaped

TEST

f. **Cuboid**

_____1) Approximately cube-shaped

_____2) Causing to stick together

_____3) Firm or solid

2. State the steps in producing good concrete.

a. ____

____

____

b. ____

____

____

c. ____

____

____

3. Name the properties of cement suitable for use as an ingredient in concrete.

a. ____

b. ____

4. State properties of water suitable for use as an ingredient in concrete.

a. ____

b. ____

5. Briefly discuss the effects of using impure water as an ingredient in concrete.

____

____

____

____

____

TEST

6. State four properties of aggregates suitable for use as an ingredient in concrete.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

7. State categories of aggregate sizes and their definitions.

a. ______________________________

____

b. ______________________________

____

8. List classes of artificial aggregates and two materials used in each class.

a. 1) Class - ______________________________

2) Materials - ______________________________

b. 1) Class - ______________________________

2) Materials - ______________________________

c. 1) Class - ______________________________

2) Materials - ______________________________

d. 1) Class - ______________________________

2) Materials - ______________________________

CONCRETE INGREDIENTS
UNIT I

ANSWERS TO TEST

1. a. 2
   b. 1
   c. 3
   d. 1
   e. 2
   f. 1

2. a. Concrete ingredients (cement, water, and aggregates) are combined in proper portions and mixed
   b. Cement and water form a paste that completely surrounds every piece of aggregate and fills all the space between aggregate particles
   c. Chemical reaction between cement and water (hydration) occurs and binds the aggregate into a strong, durable, solid mass

3. a. Dry and free-flowing
   b. Free of lumps

4. a. Tasteless and odorless
   b. Clean and free of impurities

5. Discussion should include the following.

   a. Reduces cement's bonding ability
   b. Affects concrete's setting time
   c. Stains concrete
   d. Corrodes steel used as reinforcing material

6. Answer should include any four of the following.

   a. Well-graded
   b. Clean and free from fine dust, silt, loam, clay, or vegetable matter
   c. Abrasion-resistant
   d. Freeze/thaw-resistant
   e. Approximately cuboid-shaped
   f. Hard and durable

7. a. Fine—Aggregate containing particles ranging in size from very fine up to ¼ inch
   b. Coarse—Aggregate containing particles ranging in size from ¼ inch up to the largest size that can be used on a job

ANSWERS TO TEST

8. a. 1) Class—Ultra-lightweight

   2) Materials (Answer should include any two of the following.)

   Vermiculite, expanded glass, ceramic spheres, carbonized cereals, expanded plastics, perlite

   b. 1) Class—Lightweight

   2) Materials (Answer should include any two of the following.)

   Expanded clay, expanded shale, expanded slate, sintered fly ash, expanded slag, furnace clinker, crushed brick, petroleum coke

   c. 1) Class—Normal-weight

   2) Materials (Answer should include any two of the following.)

   Iron slag, glass frits, calcined bauxite, compacted cement

   d. 1) Class—Heavyweight

   2) Materials (Answer should include the following.)

   Steel or iron shot, steel or iron pellets, steel or iron punchings

DESIGNING CONCRETE MIXES
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to discuss basic factors of concrete-mix design and define and list uses for the various types of concrete produced. The student will show this ability by completing the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with designing concrete mixes.
2. Discuss the objectives of concrete-mix design.
3. List the characteristics of quality hardened concrete.
4. List the characteristics of workable fresh concrete.
5. List the characteristics of an economical concrete mix.
6. State steps in determining optimum concrete-mix design.
7. Select from a list job requirements determined before a concrete mix is designed.
8. Name concrete-mix design factors determined to meet job requirements.
9. State the rule used to determine maximum coarse-aggregate size.
10. Name methods used to determine optimum mix proportions.
11. State types of mix designs and their definitions.
12. State adjustments made in rich mixes to achieve equal yields from air-entrained and non-air-entrained mixes.
13. State adjustments made in lean mixes to achieve equal yields from air-entrained and non-air-entrained mixes.
14. Match types of concretes to their correct definitions.
15. Match aggregates used in lightweight concretes to their correct definitions.
16. Match aggregates used in heavyweight concretes to their correct definitions.
17. State factors used in selectng aggregate for heavyweight concrete.

OBJECTIVE SHEET

18. Match types of concretes to their correct uses.

19. State standard mixing requirements for stationary mixers with up to 1-cubic-yard capacities and for truck mixers with Truck Mixer Manufacturers' Bureau-rated capacity for the size of mixer being used.

20. State standard delivery and discharge times for stationary and truck mixers.

DESIGNING CONCRETE MIXES
UNIT II

SUGGESTED ACTIVITIES

I. Instructional materials

A. Objective sheet

B. Suggested activities

1. Supplements

a. Supplement #1 — Examples of Tables Used to Determine Concrete-Mix Design

b. Supplement #2 — Typical Trial-Mix Strength Curves

c. Supplement #3 — Example of Results of Laboratory Trial Mixes

d. Supplement #4 — Sample Work Sheets for Designing and Testing Concrete Mixes

e. Supplement #5 — Completed Work Sheet for Concrete Proportions

f. Supplement #6 — Definitions of Aggregates Used in Special-Weight Concretes

g. Supplement #7 — Concrete Discharge Times

2. Transparency Master #1 — Ingredient Ratios for Concrete Mixes by Volume

C. Information sheet

D. Test

E. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

B. Obtain materials to supplement unit.

1. Cross-section samples of hardened concrete containing air voids and hardened concrete containing entrained air bubbles

2. Copies of the tables and forms in Supplements #1 through #7 to distribute to students

SUGGESTED ACTIVITIES

3. Samples of aggregates used in making special-weight concretes

4. Cross-section samples of hardened special-weight concretes

5. Transparency and competency profiles

   (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

C. Introduce unit.

SUGGESTIONS:

- Ask students to discuss what they believe a concrete-mix design is.
- Discuss how knowing the fundamentals of concrete-mix design will benefit the concrete mason.
- Take students on a field trip to a concrete plant. Have a plant official explain mix design and economy, satisfactory mix proportions, and other topics related to the unit objectives.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives.

F. Provide students with information sheet.

G. Discuss information sheet.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with designing concrete mixes.

   SUGGESTIONS:

   - Explain that sometimes during the mixing process an air-entraining cement or an air-entraining agent is incorporated into the basic concrete mix to increase the air content and improve the concrete's resistance to freeze/thaw cycles.
   - Explain the difference between air voids and entrained air, or show students cross-section samples of hardened concrete containing air voids and hardened concrete containing entrained air bubbles. Stress that entrained air bubbles are round bubbles that are *not* interconnected and are so small that they can only be seen with the aid of a microscope.

SUGGESTED ACTIVITIES

- Further explain how entraining air in the concrete improves the concrete's resistance to freezing and thawing: As water freezes, it expands, producing pressures that can rupture concrete. Because the entrained air bubbles are round and never completely fill with water, as the water freezes, its expansion is relieved by the remaining air space in the bubbles, thus preventing damage to the concrete.

- Also discuss the fact that air entrainment is recommended for all concretes that come in direct or indirect contact with deicing chemicals.

2. Use Information Sheet, Sections II through V, to discuss the objectives of concrete-mix design, characteristics of quality hardened concrete, characteristics of workable fresh concrete, and characteristics of an economical concrete mix.

SUGGESTIONS:

- Explain that the ingredients used in a concrete mix (water, cement, aggregates, and admixtures) must be combined to produce quality hardened concrete, workable fresh concrete, and an economical concrete mix.

- Discuss the concrete-mix design factors that produce a quality hardened concrete: A quality hardened concrete is freeze/thaw-resistant, watertight, wear-resistant, strong, and durable. The variables affecting the quality of hardened concrete that are controlled by the mix design are (1) the water/cement ratio; (2) aggregate gradation, strength, and durability; (3) sand/coarse-aggregate ratio; and (4) the percentage of air introduced into the mix. Other factors such as protecting the fresh concrete from damage and the method and length of curing can also affect the quality of the hardened concrete, although these factors are not discussed in conjunction with this unit.

- Discuss concrete's *workability*—the ease of placing, consolidating, and finishing concrete. To produce a workable concrete, the concrete-mix design must combine concrete ingredients in proportions that will produce a fresh concrete that flows sluggishly without segregation. Explain ***segregation*** and its causes.

- Discuss the concrete-mix design factors that produce an economical concrete. To be economical, a concrete-mix design should contain the minimum amount of cement required without sacrificing concrete quality. Economy is usually achieved by using the largest aggregate size practical, creating an optimum ratio of fine to coarse aggregates, and introducing an air-entraining agent and other admixtures into the mixture.

3. Use Information Sheet, Section VI, to discuss steps in determining optimum concrete-mix design.

SUGGESTED ACTIVITIES

4. Use Information Sheet, Sections VII through X, to discuss job requirements determined before a concrete mix is designed, concrete-mix design factors determined to meet job requirements, rule used to determine maximum coarse-aggregate size, and methods used to determine optimum mix proportions.

SUGGESTIONS:

- Explain that before a concrete mixture can be designed, certain job requirements must be known. These requirements include the size and shape of the member to be constructed, the amount and distribution of reinforcing material required to construct the member, the concrete strength required to construct the member, and the conditions the constructed member will be exposed to. Then distribute copies of the tables and work sheets in Supplements #1 through #5 and explain the step-by-step procedure used to select the concrete-mix design factors that will meet the construction requirements.

    a. Show the tables used as guides in selecting the maximum water/cement ratio permitted to meet various exposure-condition and concrete-strength requirements.

    b. Explain the rules for determining the maximum coarse-aggregate size that can be used on a project: Maximum coarse-aggregate size should not exceed one-fifth the minimum dimension of the member, three-fourths the clear space between reinforcing bars or between reinforcement and forms, or one-third the thickness of unreinforced slabs. Discuss how using the largest aggregate size possible minimizes the amount of water required, keeps the cement content to a minimum, and produces a stronger concrete.

    c. Show the tables used to determine the total air content that should be included in a mix.

    d. Explain *range of slump* and then show the tables used to determine the slump required for various types of construction.

    e. Take the information obtained from tables and rules in Supplements #1 through #3 and use the work sheets in Supplements #4 and #5 to illustrate how a mix is designed.

- Explain that after the maximum permissible water/cement ratio, maximum coarse-aggregate size, total air content, and range-of-slump requirements have been determined, trial batches are mixed to determine optimum mix proportions for both workability and economy. In both the small-lot trial mix and the job-size trial batch, the water/

SUGGESTED ACTIVITIES

cement ratio, air content, range of slump, and maximum coarse-aggregate size remain constant while the percentage of fine aggregate of total aggregate is varied. Further explain that the size of the trial batch is dependent upon the equipment available and on the number and size of the test specimens to be made. However, large batches produce more accurate data because they are made outside during normal concrete production while small-lot mixes are conducted in a laboratory where exposure conditions are difficult to duplicate.

5. Use Information Sheet, Sections XI through XIII, to define types of concrete mix designs and the adjustments made in rich and lean mixes to achieve equal yields from air-entrained and non-air-entrained mixes. Use Transparency #1, "Ingredient Ratios for Concrete Mixes by Volume," to illustrate your discussion.

6. Use Information Sheet, Sections XIV through XVIII, to define types of concrete and their uses and the aggregates used in each type.

   SUGGESTIONS:

   - Define normal-weight concrete and then relate the definitions of the other concretes to that definition.

   - Using the definitions in Table 1, have students calculate the weight per cubic yard for the different types of concrete.

   - Allow students to examine cross-section samples of normal-weight and special-weight concretes.

   - Discuss the aggregates used in making special-weight concretes, using Supplement #6, "Definitions of Aggregates Used in Special-Weight Concretes," to supplement your discussion. Show samples of these aggregates when possible.

   - Have students question suppliers and then turn in a report comparing the physical properties, availability, and costs of aggregates used in the various types of concrete.

7. Use Information Sheet, Sections XIX and XX, to discuss standard mixing requirements and standard delivery and discharge times for stationary and truck mixers.

   SUGGESTIONS:

   - While on the field trip to the batch plant, have students time the mixing process seen at the plant.

   - Have students calculate how much time or how many revolutions it will take to mix batches of different sizes.

SUGGESTED ACTIVITIES

- Explain how important it is to prevent delays when working with mixed concrete: Delays can cause concrete in trucks to begin setting during placing operations and may create difficulties for masons.
- Use Supplement #7, "Concrete Discharge Times," to expand your discussion.

H. Urge students to study the supplements in this unit.

I. Give test.

J. Critique test and discuss in class.

K. Reteach and retest if necessary.

L. Complete appropriate sections of competency profiles.

III. Unit references

A. *Cement and Concrete Terminology*: Publication SP-19 (85), ACI 11GR-85. Detroit, Michigan: American Concrete Institute, 1985.

B. *Design and Control of Concrete Mixtures*, 12th ed. Skokie, Illinois: Portland Cement Association, 1979.

C. *Guide to Durable Concrete*: AC1 201.2R-77. Detroit, Michigan: American Concrete Institute, 1982.

D. Hendrix, Laborn J. "Bud." *Cement Mason's Curriculum*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1975.

E. *Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete*: AC1 211.1-81. Detroit, Michigan: American Concrete Institute, 1981.

F. *Standard Practice for Selecting Proportions for Structural Lightweight Concrete*: AC1 211.2-81. Detroit, Michigan: American Concrete Institute, 1981.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — EXAMPLES OF TABLES USED TO DETERMINE CONCRETE-MIX DESIGN

TABLE 5.3.4(a) — RELATIONSHIP BETWEEN WATER/CEMENT RATIO AND COMPRESSIVE STRENGTH OF CONCRETE

Compressive strength at 28 days, psi*	Water/cement ratio, by weight	
	Non-air-entrained concrete	Air-entrained concrete
6000	0.41	—
5000	0.48	0.40
4000	0.57	0.48
3000	0.68	0.59
2000	0.82	0.74

*Values are estimated average strengths for concrete containing not more than the percentage of air shown in Table 5.3.3. For a constant water/cement ratio, the strength of concrete is reduced as the air content is increased.

Strength is based on 6 × 12 in. cylinders moist-cured 28 days at 73.4 ± 3F (23 ± 1.7C) in accordance with Section 9(b) of ASTM C31.

Relationship assumes maximum size of aggregate about 3/4 to 1 in.: for a given source, strength produced for a given water/cement ratio will increase as maximum size of aggregate decreases; see Sections 3.4 and 5.3.2.

TABLE 5.3.4(b) — MAXIMUM PERMISSIBLE WATER/CEMENT RATIOS FOR CONCRETE IN SEVERE EXPOSURES*

Type of structure	Structure wet continuously or frequently and exposed to freezing and thawing†	Structure exposed to sea water or sulfates
Thin sections (railings, curbs, sills, ledges, ornamental work) and sections with less than 1 in. cover over steel	0.45	0.40‡
All other structures	0.50	0.45‡

*Based on report of ACI Committee 201, "Durability of Concrete in Service," previously cited.

†Concrete should also be air-entrained.

‡If sulfate-resisting cement (Type II or Type V of ASTM C 150) is used, permissible water/cement ratio may be increased by 0.05.

All tables in this supplement used with permission of the American Concrete Institute, Detroit, Michigan.

SUPPLEMENT #1

TABLE 5.3.3 — APPROXIMATE MIXING-WATER AND AIR-CONTENT REQUIREMENTS FOR DIFFERENT SLUMPS AND NOMINAL MAXIMUM SIZES OF AGGREGATES

	Water, lb per cu yd of concrete for indicated maximum sizes of aggregate							
Slump in.	3/8 in.*	1/2 in.*	3/4 in.*	1 in.*	1- 1/2 in.*	2 in.†*	3 in.†‡	6 in.†‡
Non-air-entrained concrete								
1 to 2	350	335	315	300	275	260	220	190
3 to 4	385	365	340	325	300	285	245	210
6 to 7	410	385	360	340	315	300	270	-
Approximate amount of entrapped air in non-air-entrained concrete, percent	3	2.5	2	1.5	1	0.5	0.3	0.2
Air-entrained concrete								
1 to 2	305	295	280	270	250	240	205	180
3 to 4	340	325	305	295	275	265	225	200
6 to 7	365	345	325	310	290	280	260	—
Recommended average§ total air content, percent for level of exposure:								
Mild exposure	4.5	4.0	3.5	3.0	2.5	2.0	1.5**††	1.0**††
Moderate exposure	6.0	5.5	5.0	4.5	4.5	4.0	3.5**††	3.0**††
Extreme exposure‡‡	7.5	7.0	6.0	6.0	5.5	5.0	4.5**††	4.0**††

*These quantities of mixing water are for use in computing cement factors for trial batches. They are maxima for reasonably well-shaped angular coarse aggregates graded within limits of accepted specifications.

†The slump values for concrete containing aggregate larger than 1 1/2 in. are based on slump tests made after removal of particles larger than 1 1/2 in. by wet-screening.

‡These quantities of mixing water are for use in computing cement factors for trial batches when 3 in. or 6 in. nominal maximum size aggregate is used. They are average for reasonably well-shaped coarse aggregates, well-graded from coarse to fine.

§Additional recommendations for air-content and necessary tolerances on air content for control in the field are given in a number of ACI documents, including ACI 201, 345, 318, 301, and 302. ASTM C 94 for ready-mixed concrete also gives air-content limits. The requirements in other documents may not always agree exactly so in proportioning concrete consideration must be given to selecting an air content that will meet the needs of the job and also meet the applicable specifications.

**For concrete containing large aggregates which will be wet-screened over the 1 1/2 in. sieve prior to testing for air content, the percentage of air expected in the 1 1/2 in. minus material should be as tabulated in the 1 1/2 in. column. However, initial proportioning calculations should include the air content as a percent of the whole.

††When using large aggregate in low cement factor concrete, air entrainment need not be detrimental to strength. In most cases mixing-water requirement is reduced sufficiently to improve the water/cement ratio and to thus compensate for the strength-reducing effect of entrained-air concrete. Generally, therefore, for these large maximum sizes of aggregate, air contents recommended for extreme exposure should be considered even though there may be little or no exposure to moisture and freezing.

‡‡These values are based on the criteria that 9 percent air is needed in the mortar phase of the concrete. If the mortar volume will be substantially different from the determined in this recommended practice, it may be desirable to calculate the needed air content by taking 9 percent of the actual mortar volume.

SUPPLEMENT #1

TABLE 1.4.3 — RECOMMENDED AIR CONTENTS FOR FROST-RESISTANT CONCRETE

Nominal maximum aggregate size, in. (mm)		Average air content, percent*	
		Severe exposure†	Moderate exposure‡
3/8	(9.5)	7 1/2	6
1/2	(12.5)	7	5 1/2
3/4	(19)	6	5
1 1/2	(38)	5 1/2	4 1/2
3§	(75)	4 1/2	3 1/2
6§	(150)	4	3

*A reasonable tolerance for air content in field construction is ± 1 1/2 percent.

†Outdoor exposure in a cold climate where the concrete may be in almost continuous contact with moisture prior to freezing, or where deicing salts are used. Examples are pavements, bridge decks, sidewalks, and water tanks.

‡Outdoor exposure in a cold climate where the concrete will be only occasionally exposed to moisture prior to freezing, and where no deicing salts will be used. Examples are certain exterior walls, beams, girders, and slabs not in direct contact with soil.

§These air contents apply to the whole mix, as for the preceding aggregate sizes. When testing these concretes, however, aggregate larger than 1 1/2 in. (38 mm) is removed by handpicking or sieving and the air content is determined on the minus 1 1/2 in. (38 mm) fraction of the mix. (The field tolerance applies to this value.) From this the air content of the whole mix is computed.

There is conflicting opinion on whether air contents lower than those given in the table should be permitted for high strength (more about 5500 psi) (37.8 MPa) concrete. This committee believes that where supporting experience and/or experimental data exists for particular combinations of materials, construction practices, and exposure, the air contents may be reduced by approximately 1 percent. [For maximum aggregate sizes over 1 1/2 in. (38 mm), this reduction applies to the minus 1 1/2 in. (38 mm) fraction of the mix.]

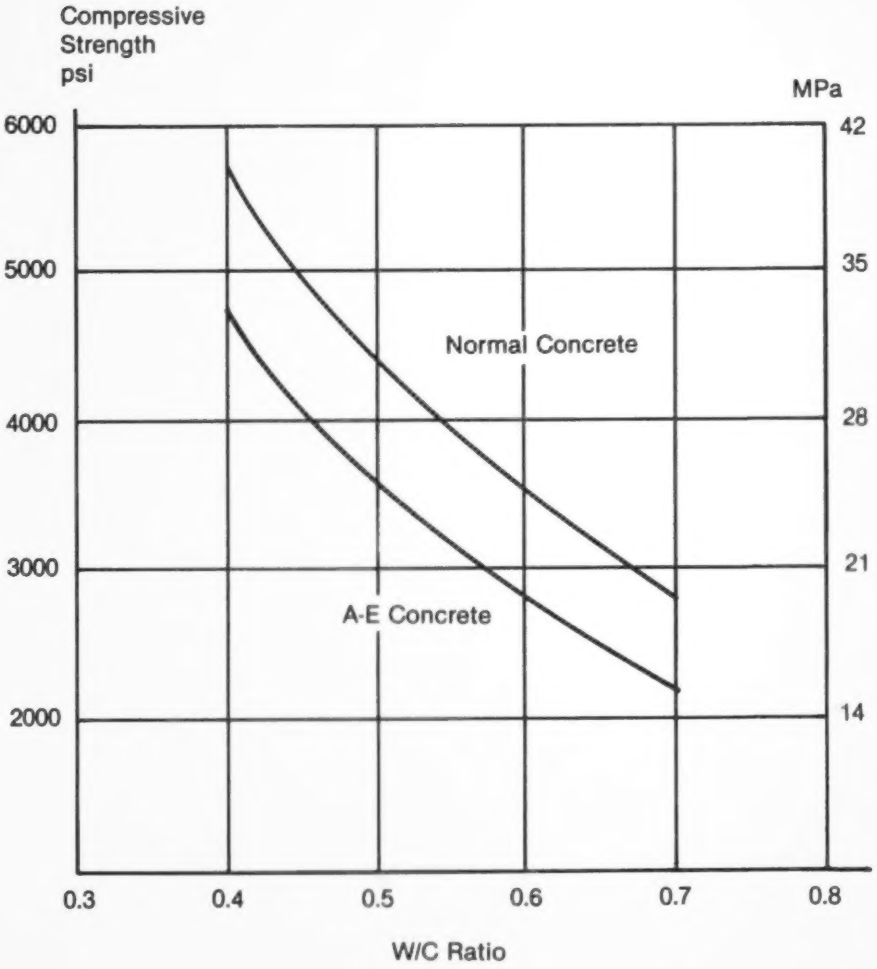
TABLE 5.3.1 — RECOMMENDED SLUMPS FOR VARIOUS TYPES OF CONSTRUCTION

Types of construction	Slump, in.	
	Maximum*	Minimum
Reinforced foundation walls and footings	3	1
Plain footings, caissons, and substructure walls	3	1
Beams and reinforced walls	4	1
Building columns	4	1
Pavements and slabs	3	1
Mass concrete	2	1

*May be increased 1 in. for methods of consolidation other than vibration.

SUGGESTED ACTIVITIES

SUPPLEMENT #2 — TYPICAL TRIAL-MIX STRENGTH CURVES



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SUGGESTED ACTIVITIES

SUPPLEMENT #3 — EXAMPLE OF RESULTS OF LABORATORY TRIAL MIXES

Batch no.	Slump, in.	Air content, percentage	Unit weight, pcf	Cement factor, lb per cubic yard	Fine aggregate, percentage of total aggregate	Workability
1	3	5.4	144	539	33.3	Good
2	2 3/4	4.9	144	555	27.4	Harsh
3	2 1/2	5.1	144	549	35.5	Excellent
4	3	4.7	145	540	30.5	Good

*Water/cement ratio selected was 0.50.

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SUGGESTED ACTIVITIES

SUPPLEMENT #4 — SAMPLE WORK SHEETS FOR DESIGNING AND TESTING CONCRETE MIXES

PROPORTIONING NORMAL-WEIGHT CONCRETE USING ACI 211.1-81
(Revised 1984)

Aggregate Analysis

Sand: Sp.G. ________: Solid Wt. ________ per cu. ft.: F.M. ________
C.A.: Top Size ________ in.: Type ________: Sp.G. ________
Solid Wt. ________ per cu. ft.: Dry rodded Wt. ________
Sol. Vol. per dry rodded cu. ft. ________: Voids ________

Coarse Aggregate (See Table 5.3.6, Page 9)

________ Solid volume of aggregate in dry rodded cu. ft.
× ________ Volume of D.R. aggregate per volume of concrete
________ Solid volume of aggregate per volume of concrete
× 27 Number of cu. ft. in cu. yd.
________ Cu. ft., solid volume of aggregate in cu. yd.
× ________ Solid weight of aggregate per cu. ft.
________ Weight of coarse aggregate in cu. yd.

Water (See Table 5.3.3, Page 5) for Slump of ________ in.

________ (lbs. per cu. yd.) ÷ 62.4 = ________ cu. ft.

Cement (See Table 5.3.4(a), Page 6, or Experience for W/C for ________ psi concrete

________ (lbs. of water per cu. yd.) ÷ ________(W/C) = ________ lbs.
________ (lbs. of cement) × .0051 = ________ cu. ft.

Entrapped or Entrained Air (See Table 5.3.3, Page 5)

________% ÷ 100 = ________ × 27 = ________ cu. ft.

Sand

________ Solid Volume of Coarse Aggregate
+ ________ Solid Volume of Water
+ ________ Solid Volume of Cement
+ ________ Volume of Air
________ Total of Above Ingredients

27.00 Volume of Concrete
– ________ Volume of Other Ingredients (above)
________ Volume of Sand
× ________ Solid Weight of Sand
________ Lbs. of Sand

Concrete Mix

________ Lbs. of Cement
________ Lbs. of Sand
________ Lbs. of Coarse Aggregate
________ Lbs. of Water

SUPPLEMENT #4

CONCRETE-MIX DESIGN CALCULATIONS

Date ____________________

For ______________________________ **Location** ______________________________

Mix ________ **Slump** ________ **Air** ________ **F.M. Sand** ________ **C.A. Size** ________ **Dry Rodded Wt.** ________

AIR ENTRAINED in 1 cu. yd. mix
From Tables or Experience = AIR ____________%

TOTAL WATER required for 1 cu. yd. mix
From Tables or Experience = Total Water ____________ lbs./cu. yd.

CEMENT required for 1 cu. yd. mix
From Tables or Experience = CEMENT ____________ lbs./cu. yd.

FLY ASH required for 1 cu. yd. mix = FLY ASH ____________ lbs./cu. yd.

COARSE AGGREGATE required for 1 cu. yd. mix
(b/b* × 27 × Dry Rodded Wt. Cu. Ft. = Aggregate/yd.) = C.A. ____________ lbs./cu. yd.
(________ × 27 × ________ lb./cu. ft. = ________)

SAND required for 1 cu. yd. mix (calculate) SOLID VOLUME

Air ________% Air × 27 = ________ cu. ft.

Water ________ gals. ÷ 7.5 =
lbs. ÷ 62.4 = ________ cu. ft.

Cement ________ lbs. ÷ 196.2 = ________ cu. ft.

Fly Ash ________ lbs. ÷ (62.4 × Sp. Gr.) = ________ cu. ft.

Coarse Agg. ________ lbs. ÷ (62.4 × Sp. Gr.) = ________ cu. ft.

TOTAL ________ cu. ft.

SAND

________ cu. ft. × 62.4 × ________ = ________ lbs./cu. yd.
× 62.4 × Sp. Gr.

TOTAL ________ cu. ft.

MIX CORRECTED FOR MOISTURE IN SAND AND ABSORPTION OR MOISTURE IN COARSE AGGREGATE

Computed Weights Cu. Yd. Saturated Surface Dry

Moisture Calculations
Sand Moisture ________%
C.A. Moisture ________%
C.A. Absorption ________%

1 Cu. Yd. Batch Wts. Adjusted for Moisture

Pozzolith ________ ozs. ________ ozs. Pozz. Sol.

Water ________ lbs. gals. ________ – ________ = ________ lbs. Water gals.

Cement ________ lbs. = ________ lbs. Cement

Fly Ash ________ lbs. = ________ lbs. Fly Ash

Sand ________ lbs. × ______% Moisture = ______ lbs. Water________ + ________ = ________ lbs. Sand

C.A. ________ lbs. × ______% Moisture = ______ lbs. Water________ + ________ = ________ lbs. C.A.
or Absorption ______

Total Wts. ________ Water Adjustment ______ lbs. Water ÷ 8.3 = ________ gals. ________ lbs.

Service Work Done By ______________________ Office ______________________

SUPPLEMENT #4

CUSTOMER ______________ CONCRETE CLASS ______________

DATE ______________ BATCH SIZE ______________

YIELD DETERMINATION

	Batched Weights	Batched 1-Yard Weights	Factor	Wt. Per Cu. Yd.
Cement			÷	
Fly Ash			″	
C. A.			″	
Sand 4cc S&Gr.			″	
Water			″	
WRA Admixture			″	
AEA Admixture			″	
Total Wt.			″	

Wt./Cu. Ft. (Total Wt./Cu. Yd. ÷ 27)

Determined Slump __________ in. Ambient Temp __________

Determined Air __________ % Concrete Temp __________

Determined Fresh Unit Wt.: __________ lbs./Cu. Ft.

$$\text{Yield} = \frac{\text{Total Wt. Per Cu. Yd.}}{\text{Fresh Unit Wt.}} = \underline{\qquad\qquad} = \underline{\qquad\qquad} \text{ Cu. Ft./Cu. Yd.}$$

__________ Cu. Ft. – __________ Cu. Ft. = __________ Cu. Ft. Over/Under Yield

$$\text{Factor} = \frac{\text{Actual Yield}}{27} = \frac{\underline{\qquad\qquad}}{27} = \underline{\qquad\qquad}$$

SUPPLEMENT #4

Laboratory-Testing
Work Sheet

Concrete Mix Design
Identification # ____

Date ____

Client: ____

Name of Job: ____

Aggregates: ____

Cement: ____

Sp. Gr. C.A. ____ Sp. Gr. F.A. ____ F. M. F.A. ____

Rodded Wt. C.A. ____ × 27 × ____ = ____

	Lab. Batch (lbs.)	Calc. Mix lb./yd.^{3}	Abs. Vol. ft.^{3}	Adj. Mix lb./yd.^{3}	Abs. Vol. ft.^{3}

Wt. cu. ft. Concrete (lb.) ____

Slump Obtained (in.) ____

Air Entrained (percent) ____

Water/Cement Ratio ____

Compression Strengths

7 Days 28 Days

Specified Strength 28 days ____ psi

SUGGESTED ACTIVITIES

SUPPLEMENT #5 — COMPLETED WORK SHEET FOR CONCRETE PROPORTIONS

WORK SHEET FOR CONCRETE PROPORTIONS

Date: 8/26/87

For:	KALAMAZOO READY MIX	Location:	KALAMAZOO, MICHIGAN
R/M:	" " "	Location:	" "
Project:	UPJOHN OFFICE BLDG.	Location:	" "
A & E:	WOLD, BOWERS, & DE SHANE	Location:	GR RAPIDS, "
CTR.:	MILLER-DAVIS CO.	Location:	KALAMAZOO, "

AGGREGATE ANALYSIS:

	F.A.	C.A.	
Size	#4	1"	(Test)
% Crushed		100%	(Visual)
F.M.	2.75		(Test)
Sp. Gr. SSD	2.62	2.82	(Test)
Sol. Wt.	163.5	176.0	(S.G. × 62.4)
Moisture, %	3.0	1.5	(Test)
D.R.W.		102.0	(Test)
b/bo*	0.675		(T. 5.4.6, ACI 211.1)
Wt. C.A., #	1859		(b/bo × 27 × D.R.W.)
Vol. C.A., ft³	10.56		(Wt. C.A. ÷ Solid Wt.)

REQUIREMENTS

Slump: 4" to 6"
Air Entr.: NONE
Strength: 4000 psi
W/C Ratio: NONE
Cmt. (Min.): NONE
Agg.: ASTM C-33
Misc.: FLOOR SLAB
Misc.:

DESIGN DATA:

Water: 332 # (Table 5.3.3, ACI 211.1 - or - experience)
W/C Ratio 0.57 by wt. (Table 5.3.4(a), ACI 211.1 - or - experience)
Cement 582 # (Water ÷ W/C Ratio)

CONCRETE PROPORTIONS

MOISTURE
C.A. = 28#
F.A. = 38#
66#

Plain Mix				Pozzolith Mix		
Volume Cu. Ft.	Dry Weights	Batch Weights		Volume Cu. Ft.	Dry Weights	Batch Weights
2.96	582# (6.25K)	582#	Cement			
10.56	1859#	1887#	C.A.			
0.41 (1.5%)			Air %			
5.33	332#	266#	Water			
NONE			Pozzolith			
19.29			Total			
7.74	1265#	1303#	Sand			
27.00	cu. ft. per yd.		Yield		cu. ft. per yd.	
0.57			W/C Ratio			
5"±1"			Slump			
4000 psi			Strength		psi (kg. F/cm²) (MPa)	

*Volume dry-rodded coarse aggregate per unit volume of concrete.

SUPPLEMENT #5

WORK SHEET FOR CONCRETE PROPORTIONS

Date: 8/26/87

Adjustment of Plain Concrete Proportion for Use of Pozzolith

1. **WATER ADJUSTMENT:** (From experience or use 5% to 10% reduction)

332 #H_2O × $\left(\frac{6\%}{100}\right)$ = 20 #H_2O ÷ 62.4 = 0.32 cu. ft. H_2O reduction (1)

2. **CEMENT ADJUSTMENT:** (From experience or reduce amount from about 50# in lean mixes to 100# in some rich mixes)

82 #Cement Reduction ÷ 196.6 = 0.42 cu. ft. cement reduction (2)

3. **ENTRAINED-AIR ADJUSTMENT:** (From experience or increase air from 0.2% to 1.5%)

$\left(\frac{0.3\%\ \text{Increase}}{100}\right)$ × 27 cu. ft. = 0.08 cu. ft. air increase (3)

Decreased Volume, cu. ft. = (1) 0.32 + (2) 0.42 + ____ (other) = −0.74 cu. ft.

Increased Volume, cu. ft. = (3) 0.08 + ____ (other) = 0.08 cu. ft.

Total Volume Change to Compensate with Aggregate Volume = 0.66 cu. ft.

AGGREGATE ADJUSTMENT: (From experience or ACI 211.1, Table 5.3.6)

The decision as to which volumes are increased or decreased is based on the following considerations

(a) Costs of fine and coarse aggregates,
(b) Design strength of mix (generally the more C.A., the higher strength),
(c) Use of concrete—workability, appearance, etc.

Fine Aggregate Add (~~Subtract~~) 0.66 cu. ft. (F.A. is ½ COST of CA & STRENGTH IS NO PROBLEM)
Coarse Aggregate Add (Subtract) ____ cu. ft.

CONCRETE PROPORTIONS ADJUSTMENTS (BY VOLUME)

	Plain Mix, cu. ft.	± Adjustments, cu. ft.	= Pozz. Treated Mix, cu. ft.
Cement	2.96	0.42	2.54
C. Agg.	10.56	—	10.56
F. Agg.	7.74	0.66	8.40
Water	5.33	0.32	5.01
Air	0.41	0.08	0.49

Pozzolith 344-N @ 5 fl. oz./wt. cement
Pozzolith ______ @ ______ fl. oz./wt. cement

SUPPLEMENT #5

WORK SHEET FOR CONCRETE PROPORTIONS

Date: 8/26/87

For:	KALAMAZOO READY MIX	Location:	KALAMAZOO, MICHIGAN
R/M:	" " "	Location:	" "
Project:	UPJOHN OFFICE BLDG	Location:	" "
A & E:	WOLD, BOWERS & DESHANE	Location:	GR RAPIDS, "
CTR.:	MILLER-DAVIS CO.	Location:	KALAMAZOO, "

AGGREGATE ANALYSIS:

	F.A.	C.A.	
Size	#4	1"	(Test)
% Crushed		100%	(Visual)
F.M.	2.75		(Test)
Sp. Gr. SSD	2.62	2.82	(Test)
Sol. Wt.	163.5	176.0	(S.G. × 62.4)
Moisture, %	3.0	1.5	(Test)
D.R.W.		102.0	(Test)
b/bo*	0.675		(T. 5.4.6, ACI 211.1)
Wt. C.A., #	1859		(b/bo × 27 × D.R.W.)
Vol. C.A., ft³	10.56		(Wt. C.A. ÷ Solid Wt.)

REQUIREMENTS

Slump: 4" to 6"
Air Entr.: NONE
Strength: 4000 psi
W/C Ratio: NONE
Cmt. (Min.): NONE
Agg.: ASTM C-33
Misc.: FLOOR SLAB
Misc.:

DESIGN DATA:

Water: 332 # (Table 5.3.3, ACI 211.1 - or - experience)
W/C Ratio 0.57 by wt. (Table 5.3.4(a), ACI 211.1 - or - experience)
Cement 582 # (Water ÷ W/C Ratio)

MOISTURE
C.A. = 28#
F.A. = 41#
69#

CONCRETE PROPORTIONS

MOISTURE
C.A. = 28#
F.A. = 38#
66#

Plain Mix				Pozzolith Mix		
Volume Cu. Ft.	Dry Weights	Batch Weights		Volume Cu. Ft.	Dry Weights	Batch Weights
2.96	582# (6.2SK)	582#	Cement	2.54	500# (5.3SK)	500#
10.56	1859#	1887#	C.A.	10.56	1859#	1887#
0.41 (1.5%)			Air %	0.49 (1.8%)		
5.33	332#	266#	Water	5.01	312#	243#
NONE			Pozzolith	344-N @ 5 FL. OZ. PER 100# CEMENT		
19.29			Total	18.60		
7.74	1265#	1303#	Sand	8.40	1373#	1414#
27.00	cu. ft. per yd.		Yield	27.00	cu. ft. per yd.	
0.57			W/C Ratio	0.62		
5" ± 1"			Slump	5" ± 1"		
4000 psi			Strength	4000	psi ~~(kg. F/cm²) (MPa)~~	

*Volume dry-rodded coarse aggregate per unit volume of concrete.

SUPPLEMENT #5

WORK SHEET FOR REPROPORTIONING CONCRETE MIXES FOR OTHER PROPERTIES

NON-AIR ENTRAINED Mixes

Materials	Class: 2000 psi			Class: 3000 psi			Class: 4000 psi		
	Volume Cu. Ft.	Dry Weights	Batch Weights	Volume Cu. Ft.	Dry Weights	Batch Weights	Volume Cu. Ft.	Dry Weights	Batch Weights
Cement	1.53	300#(3.25K)	300#	2.04	400#(4.35K)	400#	2.54	500#(5.35K)	500#
C.A. 1.5% MOIST.	10.56	1859#	1887#	10.56	1859#	1887#	10.56	1859#	1887#
Air 1.8%	0.49			0.49			0.49		
Water	5.01	312#	238#	5.01	312#	240#	5.01	312#	243#(29gal)
Pozzolith 344-N @ 5 fl. oz. per 100# CEMENT				SAME			SAME		
Total	17.59			18.10			18.60		
Sand 3% MOIST.	9.41	1538#	1584#	8.90	1454#	1498#	8.40	1373#	1414#
Yield	27.00 cu. ft./yd.			27.00 cu. ft./yd.			27.00 cu. ft./yd.		
W/C Ratio	1.04			0.78			0.62		
Slump	5" ± 1"			5" ± 1"			5" ± 1"		
Strength	2000 psi			3000 psi			4000 psi		

MOISTURE
C.A. = 28#
F.A. = 46#
74#

MOISTURE
C.A. = 28#
F.A. = 44#
72#

MOISTURE
C.A. = 28#
F.A. = 41
69#

BATCH
SAY 29 GAL

AIR ENTRAINED Mixes

Materials	Class: 2000 psi			Class: 3000 psi			Class: 4000 psi		
	Volume Cu. Ft.	Dry Weights	Batch Weights	Volume Cu. Ft.	Dry Weights	Batch Weights	Volume Cu. Ft.	Dry Weights	Batch Weights
Cement	1.53	300#(3.25K)	300#	2.04	400#(4.35K)	400	2.62	512#(5.45K)	512#
C.A. 1.5% MOIST.	10.56	1859#	1887#	10.56	1887#	1887#	10.56	1859#	1887#
Air MB-AE10	1.62			1.62			1.62		
Water 6%	4.57	285#	215#	4.57	285#	216#(26gals)	4.57	288#	220#
Pozzolith 344-N @ 5 fl. oz. per 100# CEMENT				SAME			SAME		
Total	18.28			18.79			19.37		
Sand	8.72	1426#	1468#	8.21	1342#	1383#	7.63	12.48#	1285#
Yield	27.00 cu. ft./yd.			27.00 cu. ft./yd.			27.00 cu. ft./yd.		
W/C Ratio	0.95			0.71			0.56		
Slump	5 ± 1"			5" ± 1"			5" ± 1"		
Strength	2000 psi			3000 psi			4000 psi		

MOISTURE
C.A = 28#
F.A = 42#
70#

MOISTURE
C.A. = 28#
F.A. = 41#
69#

MOISTURE
C.A. = 28#
F.A. = 37#
65#

BATCH
SAY 26 GAL

NOTE: Round aggregate weights to nearest 10 lbs.

SUGGESTED ACTIVITIES

SUPPLEMENT #6 — DEFINITIONS OF AGGREGATES USED IN SPECIAL-WEIGHT CONCRETES

Aggregates used in lightweight concretes

Blast-furnace slag — Refuse from melting of metals

Clay — Earthy material that is plastic when moist but hard when fired

Diatomite — Light, easily broken, siliceous material resembling chalk

Fly ash — Finely divided residue that results from the combustion of ground or powdered coal transported from the firebox through the boiler by flue gases

Perlite — Volcanic glass that has a concentric shelly structure and, when expanded by heat, forms a lightweight aggregate

Pumice — Volcanic glass full of cavities and very light in weight

Scoria — Cindery lava

Shale — Rock formed by the consolidation of clay, mud, or silt and resulting in a finely stratified or laminated structure

Slate — Dense fine-grained metamorphic rock produced by the compression of various sediments (clay or shale) so as to develop a characteristic cleavage

Tuff — Rock composed of the finer kinds of volcanic disintegrations

Aggregates used in heavyweight concretes

Barite — Barium sulfate occurring as a mineral

Ferrophosphorous — Iron containing phosphorous

Goethite — Mineral that consists of an iron hydrogen oxide

Hematite — Mineral constituting an important iron ore and occurring in crystals or in a red earthy form

Ilmenite — Usually massive iron-black mineral composed of iron, titanium, and oxygen

Limonite — Native hydrous ferric oxide of variable composition that is a major ore of iron

Magnetite — Black isometric mineral that is an oxide of iron

Steel shot and punchings — Scrap pellets or discs produced from metal punch presses

SUGGESTED ACTIVITIES

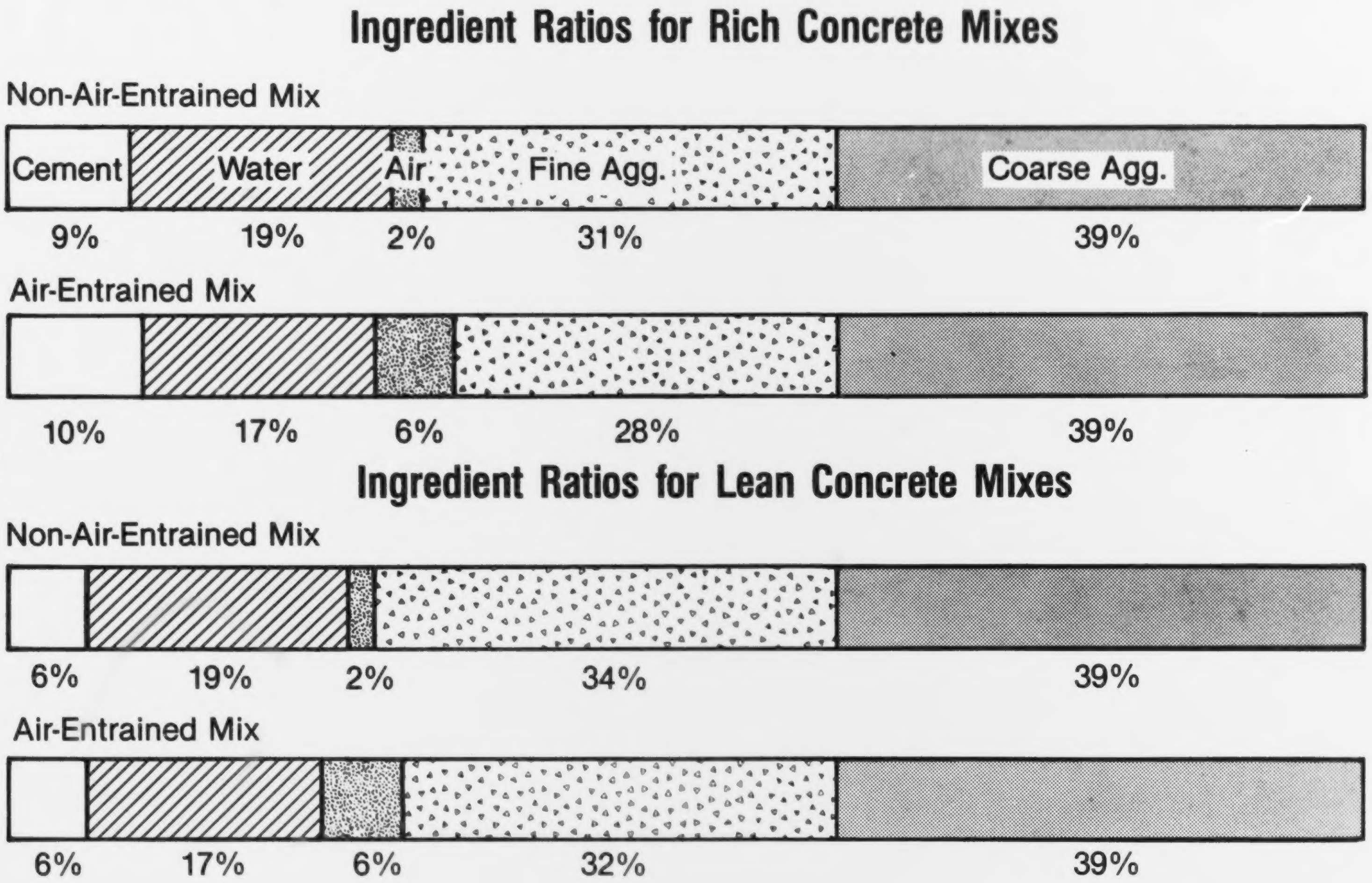
SUPPLEMENT #7 — CONCRETE DISCHARGE TIMES

Test no.	Number of revolutions			7 day*		28 day*		Wt. ft. 3	Total air %	Slump ins.	Yield ft.3/ yd. 3
	e4rpm (agitate)	e12rpm (mix)	Total revs.	Psi	% Loss	Psi	% Loss				
1	84	0	84	1920	40	2400	40	146.5	2.9	1.00	26.08
2	84	20	104	2080	35	2800	30	145.7	3.2	1.25	26.22
3	84	40	124	2270	29	3000	25	145.0	3.5	1.75	26.34
4	84	50	134	2420	24	3210	20	143.8	4.4	2.50	26.56
5	84	70	154	3200	0	4010	0	141.0	6.0	4.00	27.09

Concrete batched out of dry-batch plant then taken to job with mixer at agitate speed (4 rpm), then mixed on the job at 20, 40, 50, and 70 total revolutions at mixing speed (12 rpm). Tests were taken at various stages of mixing.

*AVERAGE OF 2–6″ × 12″ CYLINDERS, CARDBOARD MOLDS, STANDARD MOIST CURING

Ingredient Ratios for Concrete Mixes by Volume



Ingredient Ratios for Rich Concrete Mixes

Ingredient Ratios for Lean Concrete Mixes

DESIGNING CONCRETE MIXES
UNIT II

INFORMATION SHEET

I. Terms and definitions associated with designing concrete mixes

A. Workability — Ease of placing, consolidating, and finishing concrete

B. Segregate — Tendency for coarse aggregate to separate from concrete mass and accumulate to one side

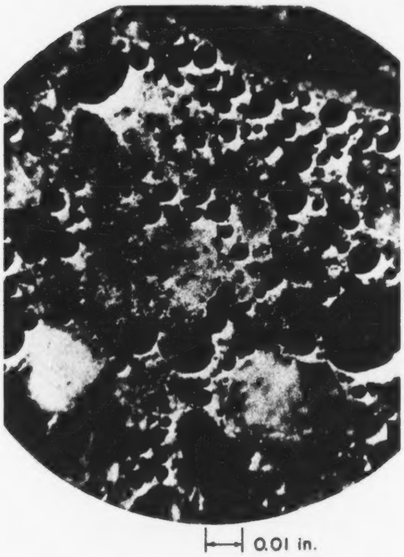
C. Range of slump — Maximum to minimum range of concrete fluidity allowed for various types of construction

D. Air-entraining agent — Admixture that develops tiny air bubbles in concrete during the mixing process

(NOTE: Unlike trapped air voids, entrained air bubbles are microscopic in size and well distributed throughout the water/cement paste, and they are *not* interconnected. See Figure 1.)

EXAMPLE:

FIGURE 1: Polished cross section of concrete with entrained air bubbles (as seen through a microscope)



Courtesy Portland Cement Association.

INFORMATION SHEET

II. Objectives of concrete-mix design

(NOTE: The ingredients used in a concrete mix [cement, water, aggregates, and admixtures] must be combined to obtain the following objectives.)

- A. To produce quality hardened concrete
- B. To produce a workable fresh concrete
- C. To produce an economical concrete

III. Characteristics of quality hardened concrete

- A. Freeze/thaw-resistant
- B. Watertight
- C. Strong
- D. Wear-resistant
- E. Durable

IV. Characteristics of workable fresh concrete

- A. Easily placed
- B. Easily consolidated
- C. Easily finished

V. Characteristics of an economical concrete mix

- A. Utilizes the largest aggregate possible
- B. Produces the stiffest mix practical
- C. Utilizes optimum ratio of fine to coarse aggregate

VI. Steps in determining optimum concrete-mix design

- A. Job requirements are determined
- B. Concrete-mix design factors are determined to meet job requirements
- C. Trial batches are mixed to determine optimum mix design

INFORMATION SHEET

VII. Job requirements determined before a concrete mix is designed

A. Size and shape of member to be constructed

B. Amount and distribution of reinforcing material required to construct member

C. Concrete strength required to construct member

D. Conditions constructed member will be exposed to

VIII. Concrete-mix design factors determined to meet job requirements

(NOTE: After the job requirements have been determined, a concrete mix is designed to meet those requirements. In designing the mix, the maximum permissible water/cement ratio, total air content, and range of slump are determined through the use of tables based on American Concrete Institute [ACI] standards. Maximum coarse-aggregate size is determined using the rule given in Objective IX.)

A. Maximum permissible water/cement ratio

B. Maximum coarse-aggregate size

C. Total air content

D. Range of slump

IX. Rule used to determine maximum coarse-aggregate size—Maximum coarse-aggregate size should *not* exceed

A. One-fifth the minimum dimension of the member to be constructed

B. Three-fourths the clear space between reinforcing bars or between reinforcement and forms

C. One-third the thickness of unreinforced slabs

X. Methods used to determine optimum mix proportions

(NOTE: After the concrete-mix design factors have been determined, trial batches are mixed. In mixing these trial batches, the percentage of fine aggregate of total aggregate is varied in order to determine the optimum mix proportions. The size of the trial batch is dependent upon the equipment available and on the number and size of the test specimens to be made; however, large batches produce more accurate data.)

A. Small, carefully proportioned trial mixes

B. Job-size trial batches made during normal concrete production

INFORMATION SHEET

XI. Types of mix designs and their definitions

A. Rich — Mix containing a high proportion of cement (See Figure 2)

B. Lean — Mix containing a low proportion of cement (Figure 3)

EXAMPLES:

FIGURE 2: Ingredient ratios for rich concrete mixes by volume

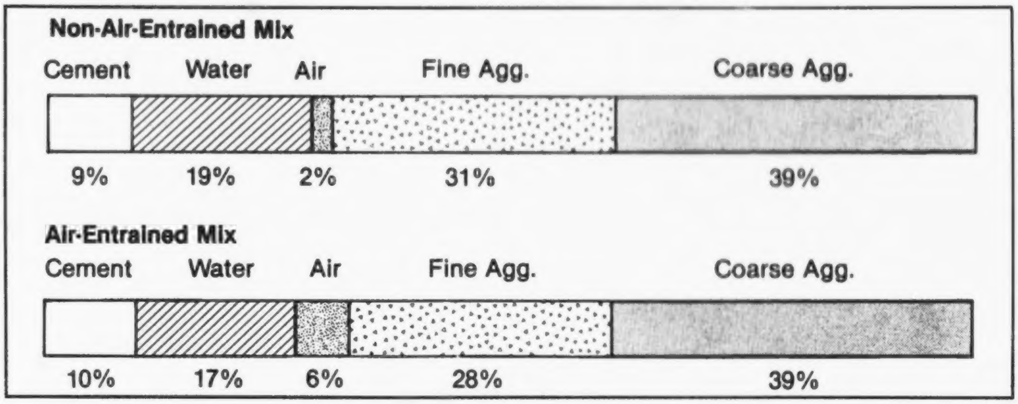
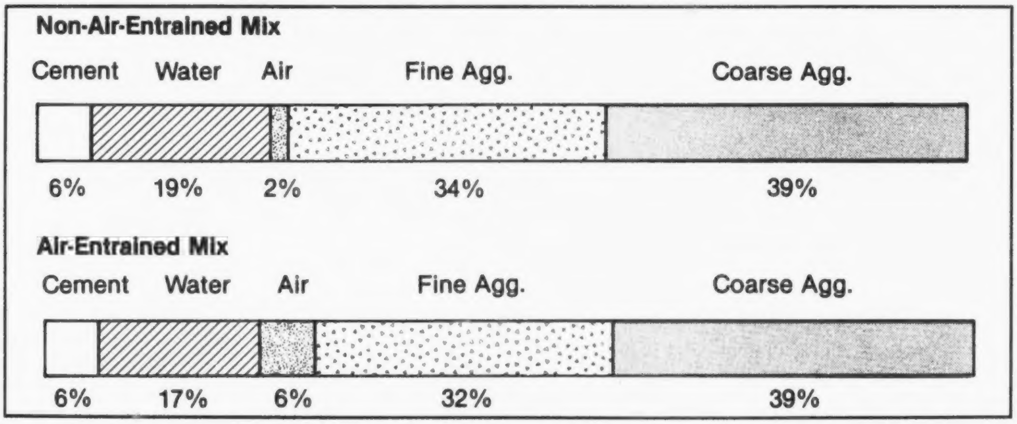


FIGURE 3: Ingredient ratios for lean concrete mixes by volume



XII. Adjustments made in rich mixes to achieve equal yields from air-entrained and non-air-entrained mixes

(NOTE: When mix adjustments are made, coarse-aggregate proportions remain constant.)

A. Adjustments made in air-entrained mixes

1. Increase proportion of air-entraining agent in mix

2. Decrease proportion of fine aggregate in mix

INFORMATION SHEET

B. Adjustments made in non-air-entrained mixes

1. Increase proportion of water in mix
2. Increase proportion of fine aggregate in mix

XIII. Adjustments made in lean mixes to achieve equal yields from air-entrained and non-air-entrained mixes

(NOTE: When mix adjustments are made, coarse-aggregate proportions remain constant.)

A. Adjustments made in air-entrained mixes

1. Decrease proportion of air-entraining agent in mix
2. Slightly increase proportion of fine aggregate in mix

B. Adjustments made in non-air-entrained mixes

1. Increase proportion of water in mix
2. Increase proportion of fine aggregate in mix

XIV. Types of concretes and their definitions (Table 1)

TABLE 1: Definitions of concrete types

Type	Definition
Normal-weight	Concrete made with aggregates such as sand, gravel, and crushed stone; and having a unit weight of approximately 150 pounds per cubic foot
Lightweight	
Group I	Lightweight insulating concrete made with aggregates of expanded materials such as perlite or vermiculite; and having a unit weight of no more than 50 pounds per cubic foot
Group II	Lightweight fill concrete made with aggregates manufactured by expanding, calcining, or sintering materials such as blast-furnace slag, clay, diatomite, fly ash, shale, or slate, or by processing natural materials such as pumice, scoria, or tuff; and having a unit weight ranging from 50 to 90 pounds per cubic foot
Group III	Lightweight structural concrete made with lightweight aggregate; and having a unit weight of 90 to 115 pounds per cubic foot

INFORMATION SHEET

TABLE 1 (Cont.)

Type	Definition
Heavyweight	Concrete made with aggregates such as barite, ferrophosphorus, goethite, hematite, ilmenite, limonite, magnetite, steel punchings, and steel shot; and having a unit weight in excess of 150 pounds per cubic foot
Colored	Concrete made by using colored aggregate and/or by adding color pigment to the mix
White	Concrete made with white cement and with aggregates and water that contain no materials to discolor the concrete

XV. Definitions of aggregates used in lightweight concretes

A. Blast-furnace slag — Refuse from melting of metals

B. Clay — Earthy material that is plastic when moist but hard when fired

C. Diatomite — Light, easily broken, siliceous material resembling chalk

D. Fly ash — Finely divided residue that results from the combustion of ground or powdered coal transported from the firebox through the boiler by flue gases

E. Perlite — Volcanic glass that has a concentric shelly structure and, when expanded by heat, forms a lightweight aggregate

F. Pumice — Volcanic glass full of cavities and very light in weight

G. Scoria — Cindery lava

H. Shale — Rock formed by the consolidation of clay, mud, or silt and resulting in a finely stratified or laminated structure

I. Slate — Dense fine-grained metamorphic rock produced by the compression of various sediments (clay or shale) so as to develop a characteristic cleavage

J. Tuff — Rock composed of the finer kinds of volcanic disintegrations

XVI. Definitions of aggregates used in heavyweight concretes

A. Barite — Barium sulfate occurring as a mineral

B. Ferrophosphorous — Iron containing phosphorus

INFORMATION SHEET

C. Goethite — Mineral that consists of an iron hydrogen oxide

D. Hematite — Mineral constituting an important iron ore and occurring in crystals or in a red earthy form

E. Ilmenite — Usually massive iron-black mineral composed of iron, titanium, and oxygen

F. Limonite — Native hydrous ferric oxide of variable composition that is a major ore of iron

G. Magnetite — Black isometric mineral that is an oxide of iron

H. Steel shot and punchings — Scrap pellets or discs produced from metal punch presses

XVII. Factors used in selecting aggregate for heavyweight concrete

A. Physical properties

B. Availability

C. Cost

XVIII. Types of concretes and their uses (Table 2)

TABLE 2: Uses of concrete types

Type	Use
Normal-weight	Used in standard concrete construction
Lightweight	
Group I	Used for insulating members such as roofs, fire walls, and conduit linings
Group II	Used in making lightweight masonry units
Group III	Used in making light but strong structural members such as those needed in high-rise buildings
Heavyweight	Used in making high-density shielding against nuclear radiation
Colored and white	Used for architectural effect

INFORMATION SHEET

XIX. Standard mixing requirements for stationary mixers with up to 1-cubic-yard capacities and for truck mixers with Truck Mixer Manufacturers' Bureau-rated capacity for the size of mixer being used

(NOTE: Mixing requirements can be found in the specifications.)

A. Stationary mixer — One minute

(NOTE: Increase the mixing time fifteen seconds for each additional yard or fraction of a yard to be mixed.)

B. Truck mixer — Seventy to one hundred revolutions at mixing speed designated by mixer manufacturer

XX. Standard delivery and discharge times for stationary and truck mixers

(NOTE: Delivery and discharge times are regulated by the American Society for Testing and Materials [ASTM].)

A. Stationary mixer — Discharge within one and one-half hours after the introduction of water into the mix

B. Truck mixer — Deliver before the drum has revolved three hundred times

DESIGNING CONCRETE MIXES
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Match terms and definitions associated with designing concrete mixes. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a. Tendency for coarse aggregate to separate from concrete mass and accumulate to one side
   1. Work
   2. Segregate
   3. Range

_____b. Admixture that develops tiny air bubbles in concrete during the mixing process
   1. Segregating agent
   2. Air-entraining agent
   3. Workability agent

_____c. Maximum to minimum range of concrete fluidity allowed for various types of construction
   1. Range of slump
   2. Workability
   3. Segregation

_____d. Ease of placing, consolidating, and finishing concrete
   1. Workability
   2. Segregation
   3. Range of slump

2. Discuss the objectives of concrete-mix design.

____

____

____

3. List the characteristics of quality hardened concrete.

a. ____

b. ____

c. ____

d. ____

e. ____

TEST

4. List the characteristics of workable fresh concrete.

a. ____________________

b. ____________________

c. ____________________

5. List the characteristics of an economical concrete mix.

a. ____________________

b. ____________________

c. ____________________

6. State steps in determining optimum concrete-mix design.

a. ____________________

b. ____________________

c. ____________________

7. Select from the following list job requirements determined before a concrete mix is designed. Write an "X" in the blank before each correct answer.

_____a. Slump

_____b. Size and shape of member to be constructed

_____c. Amount and distribution of reinforcing material required to construct member

_____d. Type of truck to be used to deliver concrete

_____e. Concrete strength required to construct member

_____f. Conditions constructed member will be exposed to

8. Name concrete-mix design factors determined to meet job requirements.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

TEST

9. State the rule used to determine maximum coarse-aggregate size.

Maximum coarse-aggregate size should *not* exceed ______________________________

____

____

____

10. Name methods used to determine optimum mix proportions.

a. ____

b. ____

11. State types of mix designs and their definitions.

a. ____

____

b. ____

____

12. State adjustments made in rich mixes to achieve equal yields from air-entrained and non-air-entrained mixes.

Adjustments made in air-entrained mixes

a. ____

b. ____

Adjustments made in non-air-entrained mixes

a. ____

b. ____

13. State adjustments made in lean mixes to achieve equal yields from air-entrained and non-air-entrained mixes.

Adjustments made in air-entrained mixes

a. ____

b. ____

TEST

Adjustments made in non-air-entrained mixes

a. ____

b. ____

14. Match types of concretes to their correct definitions. Write the correct numbers in the blanks.

_____a. Concrete made by using colored aggregate and/or by adding color pigment to the mix

_____b. Concrete made with aggregates such as barite, ferrophosphorus, goethite, hematite, ilmenite, limonite, magnetite, steel punchings, and steel shot; and having a unit weight in excess of 150 pounds per cubic foot

_____c. Lightweight fill concrete made with aggregates manufactured by expanding, calcining, or sintering materials such as blast-furnace slag, clay, diatomite, fly ash, shale, or slate, or by processing natural materials such as pumice, scoria, or tuff; and having a unit weight ranging from 50 to 90 pounds per cubic foot

_____d. Lightweight insulating concrete made with aggregates of expanded materials such as perlite or vermiculite; and having a unit weight of no more than 50 pounds per cubic foot

_____e. Concrete made with aggregates such as sand, gravel, and crushed stone; and having a unit weight of approximately 150 pounds per cubic foot

_____f. Lightweight structural concrete made with lightweight aggregate; and having a unit weight of 90 to 115 pounds per cubic foot

_____g. Concrete made with white cement and with aggregates and water that contain no materials to discolor the concrete

1. Heavyweight concrete
2. Normal-weight concrete
3. Colored concrete
4. Group I lightweight concrete
5. Group II lightweight concrete
6. Group III lightweight concrete
7. White concrete

TEST

15. Match aggregates used in lightweight concretes to their correct definitions. Write the correct numbers in the blanks.

______a. Light, easily broken, siliceous material resembling chalk

______b. Rock composed of the finer kinds of volcanic disintegrations

______c. Volcanic glass that has a concentric shelly structure and, when expanded by heat, forms a lightweight aggregate

______d. Volcanic glass full of cavities and very light in weight

______e. Earthy material that is plastic when moist but hard when fired

______f. Finely divided residue that results from the combustion of ground or powdered coal transported from the firebox through the boiler by flue gases

______g. Refuse from melting of metals

______h. Dense fine-grained metamorphic rock produced by the compression of various sediments (clay or shale) so as to develop a characteristic cleavage

______i. Rock formed by the consolidation of clay, mud, or silt and resulting in a finely stratified or laminated structure

______j. Cindery lava

1. Blast-furnace slag
2. Clay
3. Diatomite
4. Fly ash
5. Perlite
6. Pumice
7. Shale
8. Slate
9. Tuff
10. Scoria

16. Match aggregates used in heavyweight concretes to their correct definitions. Write the correct numbers in the blanks.

______a. Iron containing phosphorous

______b. Usually massive iron-black mineral composed of iron, titanium, and oxygen

______c. Black isometric mineral that is an oxide of iron

______d. Mineral that consists of an iron hydrogen oxide

______e. Mineral constituting an important iron ore and occurring in crystals or in a red earthy form

______f. Barium sulfate occurring as a mineral

______g. Scrap pellets or discs produced from metal punch presses

______h. Native hydrous ferric oxide of variable composition that is a major ore of iron

1. Barite
2. Ferrophosphorous
3. Goethite
4. Hematite
5. Ilmenite
6. Limonite
7. Magnetite
8. Steel shot and punchings

TEST

17. State factors used in selecting aggregate for heavyweight concrete.

a. ______________________________

b. ______________________________

c. ______________________________

18. Match types of concretes to their correct uses. Write the correct numbers in the blanks.

_____a. Used in standard concrete construction

_____b. Used in making light but strong structural members such as those needed in high-rise buildings

_____c. Used for insulating members such as roofs, fire walls, and conduit linings

_____d. Used in making lightweight masonry units

_____e. Used in making high-density shielding against nuclear radiation

_____f. Used for architectural effect

1. Normal-weight concrete
2. Group I lightweight concrete
3. Group II lightweight concrete
4. Group III lightweight concrete
5. Heavyweight concrete
6. Colored and white concrete

19. State standard mixing requirements for stationary mixers with up to 1-cubic-yard capacities and for truck mixers with Truck Mixer Manufacturers' Bureau-rated capacity for the size of mixer being used.

a. Stationary mixer — ______________________________

b. Truck mixer — ______________________________

20. State standard delivery and discharge times for stationary and truck mixers.

a. Stationary mixer — ______________________________

b. Truck mixer — ______________________________

DESIGNING CONCRETE MIXES
UNIT II

ANSWERS TO TEST

1. a. 2
   b. 2
   c. 1
   d. 1

2. Discussion should include the following.

   a. To produce quality hardened concrete
   b. To produce a workable fresh concrete
   c. To produce an economical concrete

3. a. Freeze/thaw-resistant
   b. Watertight
   c. Strong
   d. Wear-resistant
   e. Durable

4. a. Easily placed
   b. Easily consolidated
   c. Easily finished

5. a. Utilizes the largest aggregate possible
   b. Produces the stiffest mix practical
   c. Utilizes optimum ratio of fine to coarse aggregate

6. a. Job requirements are determined
   b. Concrete-mix design factors are determined to meet job requirements
   c. Trial batches are mixed to determine optimum mix design

7. b, c, e, f

8. a. Maximum permissible water/cement ratio
   b. Maximum coarse-aggregate size
   c. Total air content
   d. Range of slump

ANSWERS TO TEST

9. Maximum coarse-aggregate size should *not* exceed

   a. One-fifth the minimum dimension of the member to be constructed
   b. Three-fourths the clear space between reinforcing bars or between reinforcement and forms
   c. One-third the thickness of unreinforced slabs

10. a. Small, carefully proportioned trial mixes
    b. Job-size trial batches made during normal concrete production

11. a. Rich — Mix containing a high proportion of cement
    b. Lean — Mix containing a low proportion of cement

12. **Adjustments made in air-entrained mixes**

    a. Increase proportion of air-entraining agent in mix
    b. Decrease proportion of fine aggregate in mix

    Adjustments made in non-air-entrained mixes

    a. Increase proportion of water in mix
    b. Increase proportion of fine aggregate in mix

13. **Adjustments made in air-entrained mixes**

    a. Decrease proportion of air-entraining agent in mix
    b. Slightly increase proportion of fine aggregate in mix

    Adjustments made in non-air-entrained mixes

    a. Increase proportion of water in mix
    b. Increase proportion of fine aggregate in mix

14. a. 3
    b. 1
    c. 5
    d. 4
    e. 2
    f. 6
    g. 7

15. a. 3
    b. 9
    c. 5
    d. 6
    e. 2
    f. 4
    g. 1
    h. 8
    i. 7
    j. 10

ANSWERS TO TEST

16. a. 2
    b. 5
    c. 7
    d. 3
    e. 4
    f. 1
    g. 8
    h. 6

17. a. Physical properties
    b. Availability
    c. Cost

18. a. 1
    b. 4
    c. 2
    d. 3
    e. 5
    f. 6

19. a. One minute
    b. Seventy to one hundred revolutions at mixing speed designated by mixer manufacturer

20. a. Discharge within one and one-half hours after the introduction of water into the mix
    b. Deliver before the drum has revolved three hundred times

ADMIXTURES
UNIT III

UNIT OBJECTIVE

After completing this unit, the student should be able to list functions of each of the common admixture classes, and discuss reasons why the use of admixtures can benefit the concrete mason. The student will show this ability by completing the unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match to their correct definitions terms associated with admixtures.
2. State functions of each of the common admixture classes.
3. Discuss reasons why the use of admixtures can benefit the concrete mason.

ADMIXTURES
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

  C. Supplement #1 — Pozzolith® Fact Sheet

  D. Information sheet

  E. Student Supplement #1 — Common Admixtures Classified by Function

  F. Assignment sheets

    1. Assignment Sheet #1 — Compare Advantages and Disadvantages of Using Admixtures

    2. Assignment Sheet #2 — Compare Benefits and Costs of Using Admixtures

  G. Answers to assignment sheets

  H. Test

  I. Answers to test

II. Instructor's guide

  A. Review unit and plan presentation.

  B. Obtain materials to supplement unit.

    1. Audiovisual presentations

      a. A number of films and slides are available from the Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077.

      b. Slide/sound programs on admixtures are available from Master Builders, 23700 Chagrin Boulevard, Cleveland, Ohio 44122.

    2. Print material

      a. *Concrete Topics #10: Admixtures for Concrete*, n.d. Available from Kaiser Cement Corporation, Corporate Headquarters, 300 Lakeside Drive, Oakland, California 94612.

SUGGESTED ACTIVITIES

b. *Concrete Performance Data Handbook*, 1983. Available from Master Builders, 23700 Chagrin Boulevard, Cleveland, Ohio 60077.

c. *Design and Control of Concrete Mixtures*, 12th ed., 1979. Available from the Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60077.

(NOTE: The following print materials are available from the American Concrete Institute, Box 19150, Redford Station, Detroit, Michigan 48219.)

d. *Cement and Concrete Terminology*, ACI 116 R85, 1985.

e. *Guide for Use of Admixtures in Concrete*, ACI 212.2 R-81 (Revised 1982).

f. *Admixtures for Concrete*, ACI 212.1 R (Revised 1982).

g. *State-of-the-Art Report on Fiber-Reinforced Concrete*, ACI 544.1 R-82, 1982.

3. Copies of Supplement #1

4. Samples of admixtures

5. Several sets of flash cards with an admixture class written on one side of each card and a function written on the other side.

6. Competency profiles

(NOTE: Competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

C. Introduce unit.

SUGGESTIONS:

- Invite a representative from one of the admixture producers (Master Builders, W. R. Grace) to talk with the class and demonstrate the results of using some admixtures in a concrete mix.
- Show audiovisual presentations or hand out print materials to introduce students to admixtures.
- Hand out copies of Supplement #1, "Pozzolith® Fact Sheet," and discuss additive systems.

D. Provide students with objective sheet.

SUGGESTED ACTIVITIES

E. Discuss unit and specific objectives.

F. Provide students with information sheet, student supplement, and assignment sheets.

G. Discuss information sheet, student supplement, and assignment sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with admixtures.

   SUGGESTIONS:

   - Show students examples of admixtures in general, and of a pozzolan in particular.
   - Mix a small amount of concrete to demonstrate the terms *workability*, *plasticity*, and *slump*.
   - Put a small slab of hardened concrete in a container of wet sand to demonstrate the term *permeability*.

2. Use Information Sheet, Section II, to discuss common admixture classes and their functions.

   SUGGESTIONS:

   - Have students refer to Student Supplement #1, "Common Admixtures Classified by Function," while you review the information presented in Section II. Then have students break into groups of two. Have one student show the other the side of a flash card with an admixture class name and have the student give the function of that admixture class. Have students keep score of the functions they are able to correctly identify. Have students trade places.
   - Show audiovisual presentations or hand out print material you have selected.

3. Use Information Sheet, Section III, to discuss the reasons why the use of admixtures can benefit the concrete mason. Use Assignment Sheet #1, "Compare Advantages and Disadvantages of Using Admixtures," and Supplement #2, "Compare Benefits and Costs of Using Admixtures," to expand your discussion.

H. Review unit.

I. Give test.

J. Reteach and retest as necessary.

K. Complete appropriate sections of competency profiles.

SUGGESTED ACTIVITIES

III. Unit references

A. *Annual Book of ASTM Standards: "Concrete and Mineral Aggregates,"* Section 4, Volume 04.02, including (C-9 on Concrete and Concrete Aggregates and D-4 on Road and Paving Materials [partial].) Philadelphia: American Society for Testing and Materials, 1985.

B. *Cement and Concrete Terminology,* Publication SP-19(85) AC1 116R-85. Detroit, Michigan: American Concrete Institute, 1985.

C. *Concrete Performance Data Handbook.* Cleveland, Ohio: Master Builders, Division of Martin Marietta Corporation, 1983.

D. *Concrete Topics #10: Admixtures for Concrete.* Ontario, California: Kaiser Cement Corporation, Technical Department, n.d.

E. *Design and Control of Concrete Mixtures,* 12th ed. Skokie, Illinois: Portland Cement Association, 1979.

F. *Guide for Use of Admixtures in Concrete,* ACI 212.2 R-81 (Revised 1982). Detroit, Michigan: American Concrete Institute, 1982.

G. Hendrix, Laborn J. "Bud." *Cement Masons Curriculum.* Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1975.

H. *State-of-the-Art Report on Fiber-Reinforced Concrete,* Report No. ACI 544.1 R-82. Detroit, Michigan: American Concrete Institute, 1982.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — POZZOLITH® FACT SHEET

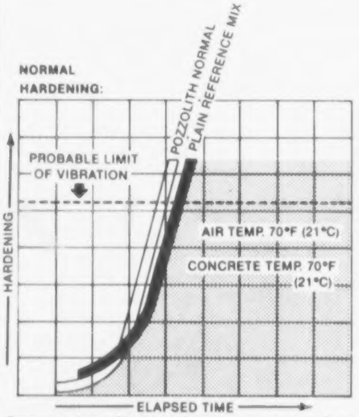
The use of Pozzolith admixtures improves concrete properties by reducing the unit water content while improving the cement hydration reaction and controlling its rate of hardening.

HOW POZZOLITH® ADMIXTURES IMPROVE CONCRETE PROPERTIES

1. **Controls rate of hardening:** The basic types of Pozzolith admixtures provide the desired handling, placing, and finishing time plus important structural benefits.

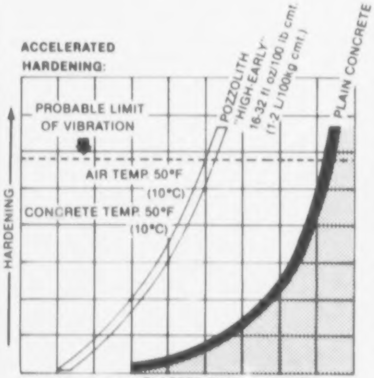
2. **Improves hydration reaction:** At a given water/cement ratio equal to that of a plain concrete, strengths of concrete treated with Pozzolith admixture will be higher at all ages.

3. **Reduces water content:** Pozzolith admixtures reduce mixing-water content required for a given workability.



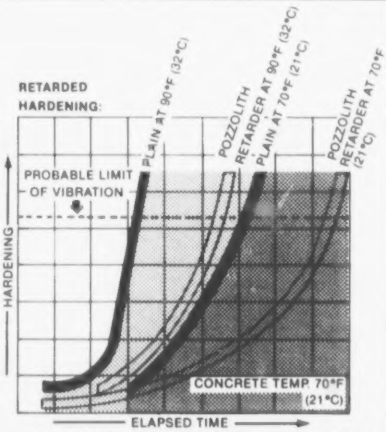
Comparison of rates of hardening of a concrete mix containing Pozzolith normal admixture and a plain mix at 70°F (21°C) — both mixes designed to same slump and strength.

Normal hardening: Concrete containing Pozzolith normal-setting admixture has essentially the same rate of hardening as a plain concrete mix of equal strength.



Comparison of hardening rate of concrete containing Pozzolith high early admixture and a plain reference mix. All concrete mixed at 50°F (10°C). Equal cement (Type I) content and same slump for both mixes.

Accelerated hardening: Pozzolith high-early-setting admixtures accelerate the setting time of concrete while producing higher early and higher ultimate strengths. They facilitate earlier finishing of concrete flatwork.



Comparison of rates of hardening of mixes containing Pozzolith retarding admixture and plain mixes designed to the same slump and strength. The concretes were mixed and exposed to temperatures indicated on the chart.

Retarded hardening: Pozzolith retarding admixtures aid in overcoming difficulties in mixing, handling, placing, and finishing concrete at high temperatures. Its advantages include:

a) Greater flexibility in the scheduling of finishing operations for large areas.
b) Overcoming stiffening in route when concrete is in the mixer for extended periods.
c) Reduced cracking of concrete slabs and paving from premature stiffening of surface.
d) Elimination of cold joints between subsequent lifts in mass or structural concrete.

At 70°F (21°C), Pozzolith retarding admixtures delay the set 1-3 hours or longer, depending on the formulation and dosage.

At 90°F (32°C), concrete can be made to set like plain concrete at 70°F (21°C) with the use of the appropriate Pozzolith retarding admixture.

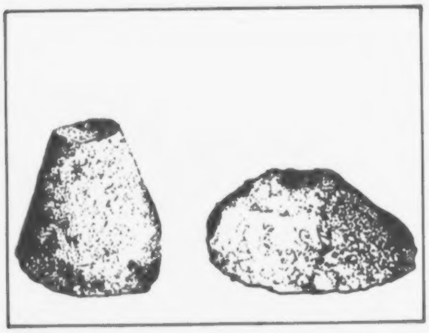
Note: *Above 90°F (32°C) or for greater retardation, the amount of Pozzolith retarding admixture per 100 lb (45 kg) of cement may be increased, preferably on the basis of tests made with job materials.*

Used with permission of Master Builders, Cleveland, Ohio.

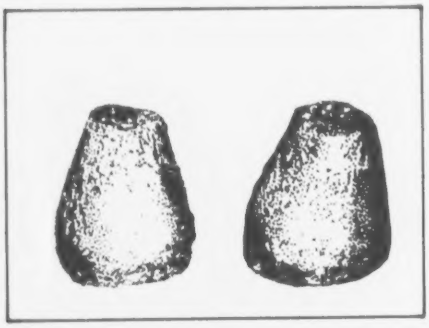
SUPPLEMENT #1

The effects of Pozzolith admixtures on concrete are (a) in the plastic state — improved cohesiveness, workability, and finishing; (b) in the hardened state — increased compressive and flexural strengths, reduced permeability, increased durability, and improved finished appearance.

ADVANTAGES OF POZZOLITH®



Plain Mix		Pozzolith Mix
0.60	W/C	0.60
3 inches (75 mm)	Slump	7½ inches (190 mm)



Plain Mix		Pozzolith Mix
0.60	W/C	0.48
3 inches (75 mm)	Slump	3 inches (75mm)

1. Pozzolith admixtures improve workability:

Workability is that property of freshly mixed concrete that determines the homogeneity and ease with which it can be mixed, placed, compacted, and finished. Pozzolith admixtures can improve the workability of concrete in two ways: increase workability and slump without the addition of extra water; and/or increase workability for a given slump using less water.

a) Increased slump without additional water — (top photo at left) It is easily demonstrated that the addition of Pozzolith admixture to an existing concrete mix results in a 100 to 150% increase in the slump of that mix. Pozzolith admixture used in this manner is functioning as a plasticizing admixture, making the concrete more workable and more easily placeable without altering the water/cement ratio and yet increasing the strength of the hardened concrete. This increased workability, without the use of extra water, is of special importance in placing concrete in heavily reinforced sections or in intricate forms.

b) Same slump with reduced water content (lower photo, left) — In designing a concrete mix of a given slump, less mixing water is required in the Pozzolith mix than in the comparable, untreated concrete, be it a plain concrete or air-entrained concrete. Even at the same slump, the Pozzolith mix is visibly more cohesive, with better coating of aggregate by cement paste. It yields better to spading and vibration and flows better around steel reinforcing. When forms are stripped, it presents a better finished appearance with greater freedom from honeycomb. It requires less rubbing and finishing — with improvements in the hardened concrete properties discussed in the following pages.

SUPPLEMENT #1

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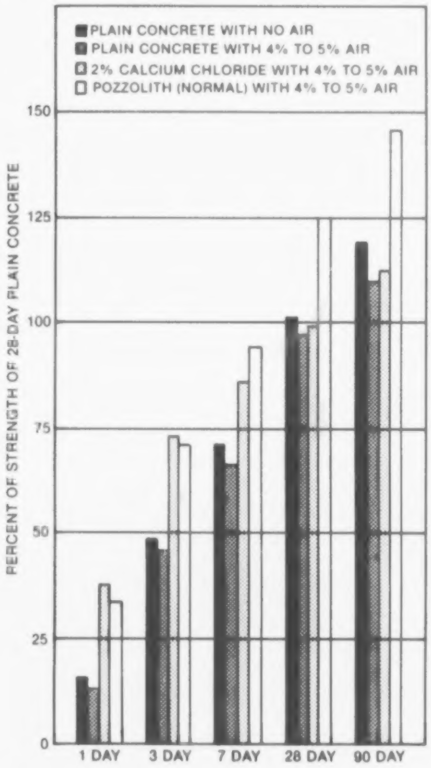
2. Pozzolith® admixtures improve strength:

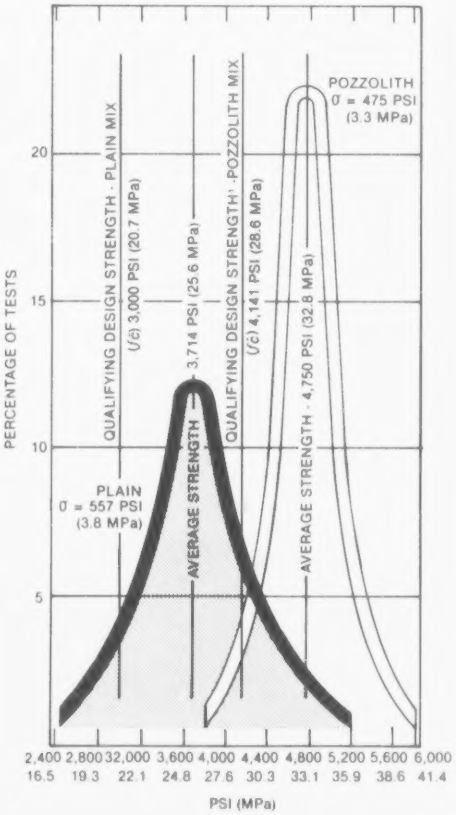
Increased compressive and flexural strengths — For a given workability, concrete in which Pozzolith admixtures are used has these advantages:

a) Greater compressive strength and a corresponding increase in flexural strength over both plain and air-entrained concrete.

b) Unlike concrete produced with a single air-entraining and accelerating admixture, concrete in which Pozzolith admixtures are used has increased strength at all ages (see charts below).



Comparison of strength of different concretes at various ages — based on averages of several hundred tests by comercial testing laboratories covering the range of cements and aggregates used in the field



[1] Based on Class 1 concrete (ASTM C 94) such that no more than 1 in 10 tests will fall below strength f_c

Chart illustrates the higher compressive strength and lower standard deviation you can expect to obtain from a concrete mix containing Pozzolith polymer-type admixture compared to a similar plain concrete mix with an average standard deviation, reducing only the water content of the concrete with Pozzolith admixture to maintain the same slump.

SUPPLEMENT #1

---

3. Pozzolith® admixtures reduce shrinkage cracking:

Drying shrinkage is affected principally by total water content. It is also affected to a smaller degree by other factors such as cement content, and amount and type of aggregate.

Pozzolith admixtures reduce shrinkage cracking by reducing unit water content, increasing the bond of cement paste to aggregate and the tensile strength of the paste itself, and by improving the overall uniformity of the concrete.

The proof of performance is found in the structures themselves. Engineers reported marked reduction in shrinkage cracking of concrete containing Pozzolith admixtures as compared with other portions of the same structure, or similar structures, where plain concretes were employed.

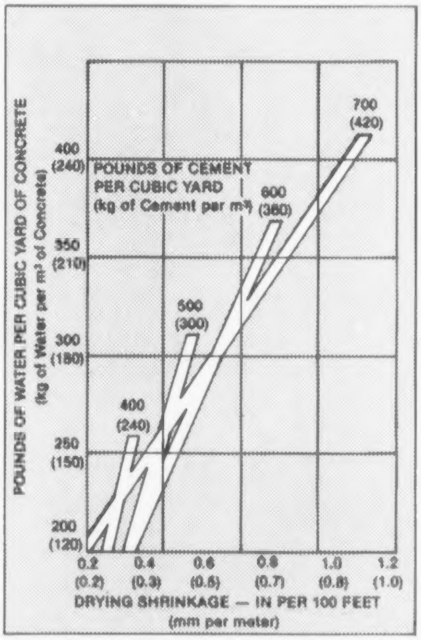


Chart developed from data in the U.S. Bureau of Reclamation Concrete Manual, 8th Edition, page 16, shows the relation between drying shrinkage, unit water content, and cement content of fresh concrete

4. Pozzolith admixtures increase watertightness:

Studies by the Bureau of Reclamation, the Corps of Engineers, and others show that permeability is related directly to water content. Approximately 25 lb (11 kg) of water per 100 lb (45 kg) of cement are required to hydrate the cement. The balance — "excess" water — is necessary only to provide workability for placement purposes.

Some of the excess water bleeds from the mass and, in so doing, forms voids and a network of thread-like interconnecting passages. Water reenters these passages in the hardened concrete. Any decrease in total water means a decrease in the size and number of these passages. The problem is how to decrease water without affecting the workability and placeability of the concrete.

Pozzolith admixtures make possible the lowest water content for a given workability, thereby reducing the network of capillaries and voids. Along with reduced shrinkage cracking, this further lowers the permeability of the concrete.

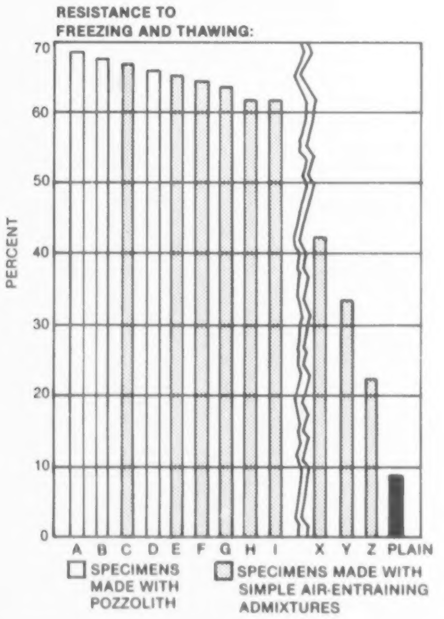
5. Pozzolith admixtures improve durability:

A number of government agencies and technical groups have investigated the durability of plain and air-entrained concrete containing Pozzolith admixture as well as concretes made with other water-reducing, set-controlling admixtures.

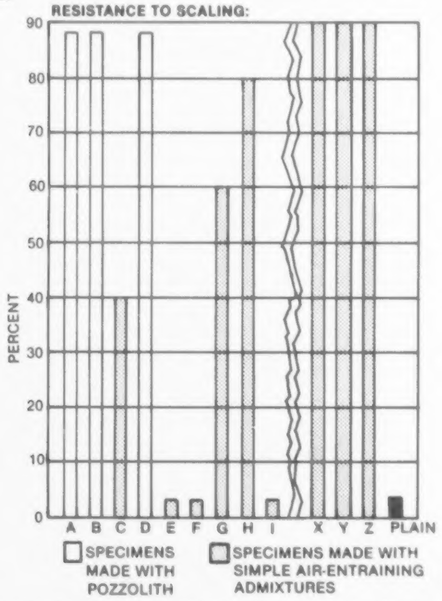
The data show improved durability in the air-entrained concrete containing Pozzolith admixtures for resistance to repeated cycles of freezing and thawing.

Pozzolith admixtures used in concrete mixes containing 5 to 7% entrained air provide maximum durability because they permit the use of lowest total water content while providing high-strength, low-permeable concrete that is easier to place, handle, and finish properly.

SUPPLEMENT #1



Relative resistance to cycles of freezing and thawing of concretes made with 26 different air-entraining admixtures, reported in Public Roads, Vol. 27, No. 12, Feb., 1954, published by the U.S. Bureau of Public Roads.



Relative resistance to scaling from deicing salts and natural weathering of concretes made with 26 different air-entraining admixtures, reported in Public Roads, Vol. 28, No. 7, April, 1955, published by the U.S. Bureau of Public Roads.

Pozzolith admixtures can be used with Master Builders MB-VR® or MB-AE® 10 air-entraining admixtures.

6. Pozzolith admixtures improve appearance:

Pozzolith admixtures improve cohesiveness and plasticity, thereby helping to avoid honeycombing and other segregation defects. The problems of sandstreaking and cold joints are also minimized or more easily overcome with Pozzolith admixtures. Because of these advantages, when forms are stripped, concrete containing Pozzolith admixtures requires less finishing and rubbing, and produces the sharp details required in architectural concrete. Where heavy reinforcement limits the placement area, the Pozzolith Admixture System's Flowable Concrete approach may yield the best results.

With concrete treated with Pozzolith admixtures, the surface is dense and has low absorption. These are direct results of reduced mixing water, improved aggregate coating, and the cohesiveness of concrete — all made possible by the use of these admixtures.

Whenever and wherever concrete is used, concrete made with Pozzolith admixtures meets your architectural, structural, and construction requirements better than plain concrete or concrete made with any other admixture.

Specify admixture per example:

All concrete shall contain Master Builders Pozzolith, a water-reducing admixture, used in accordance with the manufacturer's recommendations. Where controlled setting time and/or rate of hardening is required, the admixture shall be a formulation that provides this control without loss in strength when compared with the normal setting formulation. The manufacturer shall make available at no cost, upon 72 hours notice, the services of a qualified representative to assure proper use of the admixture.

More complete product specifications are available upon request from Master Builders, Cleveland, Ohio 44122

ADMIXTURES
UNIT III

INFORMATION SHEET

I. Terms and definitions associated with admixtures

   A. Admixture — Agent added to concrete mix immediately before or during mixing to alter one or more concrete characteristic

   B. Workability — Ease with which concrete can be placed, consolidated, and finished

   C. Bleeding — Emergence of mixing water on the surface of newly placed concrete; caused by settlement of solid materials within the mass

   D. Slump — Measure of consistency of freshly mixed concrete

   E. Pozzolan — Material that when combined with moisture will react with calcium hydroxide at ordinary temperatures to form compounds possessing properties of cement

   F. Plasticity — Capacity for being flexible or workable

   G. Permeability — Degree to which liquids or gases are capable of passing through a substance

II. Common admixture classes defined by function

   (NOTE: Quality concrete should be workable, strong, durable, and waterti[illegible] These properties can usually be produced most economically by selecting quality basic concrete ingredients: cement, water, and aggregates. However, sometimes conditions require concrete properties that extend or reduce setting time, accelerate early-strength development, increase workability, or improve weather resistance. Then, admixtures are added to the mix design before or during mixing.)

   A. Air-entraining

      (NOTE: Air-entraining agents such as salts of wood resins, some synthetic detergents, salts of sulfonated lignin, salts of petroleum acids, fatty and resinous acids and their salts, and alkylbenzene sulfonates are used to entrain microscopic air bubbles in concrete to permit the use of harsher and more poorly graded aggregates and to improve concrete resistance to freeze/thaw cycles and deicing chemicals.)

      1. Improve durability

      2. Increase workability

      3. Reduce bleeding

INFORMATION SHEET

B. Retarding

(NOTE: Retarding admixtures such as lignin, borax, sugars, and tartaric acid and salts are used in concrete [1] to offset the accelerating effects of hot weather on the setting of concrete and [2] to delay the set when difficult or unusual conditions of placement are required. Because most retarding admixtures also act as water-reducing agents, you may also hear them being referred to as *water-reducing retarders*.)

1. Delay setting time
2. Offset adverse high-temperature weather conditions

C. Accelerating

(NOTE: Accelerating admixtures such as calcium chloride and triethanolamine are used during cold weather to accelerate set so that forms can be removed earlier and also to make concrete more resistant to freezing at an early age.)

1. Speed setting time
2. Speed early-strength development
3. Offset adverse low-temperature weather conditions

D. Water-reducing

EXAMPLES: Lignosulfonates, hydroxylated carboxylic acids

1. Reduce quantity of mix water needed for a given consistency
2. Increase workability without decreasing strength
3. Increase slump

E. Superplasticizer (high-range water-reducing)

(NOTE: Superplasticizers are super-water-reducing admixtures capable of producing large water reduction or great flowability without causing air entrainment or retarding set. Sulfonated melamine formaldehyde condensates and sulfonated naphthalene formaldehyde condensates are used as superplasticizers.)

1. Greatly reduce quantity of mix water needed
2. Increase workability without decreasing strength
3. Increase slump

INFORMATION SHEET

F. Pozzolan

EXAMPLES: Natural materials such as diatomaceous earth, opaline cherts and shales, tuffs and pumicities; artificial materials such as fly ash

1. Improve workability
2. Improve plasticity

G. Waterproofing and dampproofing

EXAMPLES: Stearate of calcium, aluminum, ammonium, or butyl; petroleum greases or oils; soluble chlorides

1. Decrease permeability
2. Preserve designed strength

H. Pigment — Add color

(NOTE: Finely ground pure mineral oxides are added to concrete to produce colored hardened concretes that create decorative effects, reduce glare, and mark highways, aisles and hazardous areas in industrial plants, and underground utilities.)

I. Fiber reinforcement

(NOTE: Strictly speaking, both plastic- and steel-fiber strand reinforcement should not be classified as additives; they are actually used as alternatives to wire-fabric reinforcement. However, since both types of fiber reinforcement are added during mixing, fiber reinforcement has been listed here.)

1. Reduce surface cracking
2. Increase strength
3. Decrease permeability

III. Reasons why the use of admixtures can benefit the concrete mason

A. Admixtures can provide setting-time variations required for finishing

B. Admixtures can produce a more workable concrete mix

C. Admixtures can reduce bleeding

ADMIXTURES
UNIT III

STUDENT SUPPLEMENT #1 — COMMON ADMIXTURES CLASSIFIED BY FUNCTION

Class	Function	Agent
Air-entraining	Improve durability Increase workability Reduce bleeding	Salts of wood resins Some synthetic detergents Salts of sulfonated lignin Salts of petroleum acids Fatty and resinous acids and their salts Alkylbenzene sulfonates
Retarding	Delay setting time Offset adverse high-temperature weather conditions	Lignin Borax Sugars Tartaric acid and salts
Accelerating	Speed setting time Speed early-strength development Offset adverse low-temperature weather conditions	Calcium chloride Triethanolamine
Water-reducing	Reduce quantity of mix water needed for a given consistency Increase workability without decreasing strength Increase slump	Lignosulfonates Hydroxylated carboxylic acids
Superplasticizer (high-range water-reducing)	Greatly reduce quantity of mix water needed Increase workability without decreasing strength Increase slump	Sulfonated melamine formaldehyde condensates Sulfonated naphthalene formaldehyde condensates
Pozzolan	Improve workability Improve plasticity	Natural materials: Diatomaceous earth Opaline cherts and shales Tuffs and pumicites Artificial material: Fly ash
Waterproofing and dampproofing	Decrease permeability Preserve designed strength	Stearate of calcium, aluminum, ammonium, or butyl Petroleum greases or oils Soluble chlorides
Pigment	Add color	Pure mineral oxides
Fiber reinforcement	Reduce surface cracking Increase strength Decrease permeability	Plastic fiber Metal fiber

ADMIXTURES
UNIT III

ASSIGNMENT SHEET #1 — COMPARE ADVANTAGES AND DISADVANTAGES OF USING ADMIXTURES

NAME ____________________ SCORE __________

You learned in Section III of the information sheet that admixtures can benefit the concrete mason by providing setting-time variations required for finishing operations, producing a more workable concrete mix, and reducing bleeding. Some concrete masons may be able to list other benefits of using admixtures in a concrete mix; however, some masons may believe that there are disadvantages to the use of admixtures. You need to be aware of both the advantages and disadvantages of working with admixtures in the concrete mix.

Obtain permission to visit a construction site where concrete masons are working with concrete containing admixtures. Interview the concrete masons, and on the blanks below, write a short report comparing the advantages and disadvantages concrete masons face when required to work with admixtures in the concrete mix.

ADMIXTURES
UNIT III

ASSIGNMENT SHEET #2 — COMPARE BENEFITS AND COSTS OF USING ADMIXTURES

NAME ______________________________ SCORE ______________

As you have learned in previous units, quality concrete can usually be obtained most economically by using quality ingredients in the basic mix: dry, free-flowing cement; clean water; and strong, well-graded aggregates. Sometimes though special concrete properties are required to decrease or extend the time of set, accelerate the rate of early strength development, etc. Then it may be desirable to use an admixture in the mix. When possible, however, a comparison should be made between the cost of changing the basic mix and the additional costs of using an admixture.

Obtain permission to visit a batch plant where concrete containing admixtures is being mixed. Interview personnel and, on the blanks below and on the next page, write a short report comparing the cost of changing the basic mix with the additional cost of using an admixture. The comparison should include, in addition to the cost of the admixture, any effect the use of the admixture will have on the cost of transporting, placing, finishing, curing, and protecting the concrete.

ASSIGNMENT SHEET #2

ADMIXTURES
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1 — Evaluated to the satisfaction of the instructor

Assignment Sheet #2 — Evaluated to the satisfaction of the instructor

ADMIXTURES
UNIT III

TEST

NAME ______________________ SCORE ____________

1. Match to their correct definitions terms associated with admixtures. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a. Degree to which liquids or gases are capable of passing through a substance
   1. Plasticity
   2. Workability
   3. Permeability

_____b. Material that when combined with moisture will react with calcium hydroxide at ordinary temperatures to form compounds possessing properties of cement
   1. Admixture
   2. Pozzolan
   3. Slump

_____c. Ease with which concrete can be placed, consolidated, and finished
   1. Workability
   2. Plasticity
   3. Permeability

_____d. Agent added to concrete mix immediately before or during mixing to alter one or more concrete characteristic
   1. Pozzolan
   2. Admixture
   3. Slump

_____e. Capacity for being flexible or workable
   1. Workability
   2. Plasticity
   3. Permeability

_____f. Measure of consistency of freshly mixed concrete
   1. Slump
   2. Plasticity
   3. Workability

_____g. Emergence of mixing water on the surface of newly placed concrete; caused by settlement of solid materials within the mass
   1. Pozzolan
   2. Slump
   3. Bleeding

TEST

2. State one function of each of the common admixture classes listed below.
   a. Air-entraining — ____________________
   b. Retarding — ____________________
   c. Accelerating — ____________________
   d. Superplasticizer (high-range water-reducing) — ____________________
   e. Pozzolan — ____________________
   f. Water-reducing — ____________________
   g. Waterproofing and dampproofing — ____________________
   h. Pigment — ____________________
   i. Fiber reinforcement — ____________________
3. Discuss reasons why the use of admixtures can benefit the concrete mason.

____

____

____

ADMIXTURES
UNIT III

ANSWERS TO TEST

1. a. 3
   b. 2
   c. 1
   d. 2
   e. 2
   f. 1
   g. 3

2. Answer should include one for each of the following

   a. Air-entraining

      (1) Improve durability
      (2) Increase workability
      (3) Reduce bleeding

   b. Retarding

      (1) Delay setting time
      (2) Offset adverse high-temperature weather conditions

   c. Accelerating

      (1) Speed setting time
      (2) Speed early-strength development
      (3) Offset adverse low-temperature weather conditions

   d. Superplasticizer (high-range water-reducing)

      (1) Greatly reduce quantity of mix water needed
      (2) Increase workability without decreasing strength
      (3) Increase slump

   e. Pozzolan

      (1) Improve workability
      (2) Improve plasticity

   f. Water-reducing

      (1) Reduce quantity of mix water needed for a given consistency
      (2) Increase workability without decreasing strength
      (3) Increase slump

   g. Waterproofing and dampproofing

      (1) Decrease permeability
      (2) Preserve designed strength

ANSWERS TO TEST

h. Pigment — Add color

i. Fiber reinforcement

  (1) Reduce surface cracking
  (2) Increase strength
  (3) Decrease permeability

3. Discussion should include the following.

  a. Admixtures can provide setting-time variations required for finishing
  b. Admixtures can produce a more workable concrete mix
  c. Admixtures can reduce bleeding

SPECIFICATIONS AND TESTING
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to read and interpret specifications pertaining to concrete and perform sampling and testing procedures concrete masons commonly conduct on fresh concrete. The student will show this ability by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Select correct definitions of terms associated with specifications and testing.
2. Discuss reasons concrete masons read specifications
3. Select from a list concrete-related factors included in specifications.
4. Match to their correct descriptions types of fresh-concrete and hardened-concrete sampling and testing procedures commonly performed by concrete masons.
5. Read and interpret specifications pertaining to concrete.
6. Demonstrate the ability to
    a. Obtain representative fresh-concrete test samples (ASTM C 172-82).
    b. Perform a slump test (ASTM C 143-78).
    c. Make a cylinder-mold test specimen (ASTM C 31-84).
    d. Make a beam-mold test specimen (ASTM C 31-84).
    e. Perform volumetric-method air-content test (ASTM C 173-78).
    f. Use Type-B air meter to perform pressure-method air-content test (ASTM C 231-82^{E1}).
    g. Perform temperature test.
    h. Perform unit-weight test (ASTM C 29-78^{E2}).

SPECIFICATIONS AND TESTING
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

  A. Objective sheet

  B. Suggested activities

    1. Supplement #1 — Typical Test Form

    2. Transparency masters

      a. TM #1 — Fresh-Concrete Testing Procedures

      b. TM #2 — Fresh-Concrete Testing Procedures (Continued)

      c. TM #3 — Fresh-Concrete Testing Procedures (Continued)

      d. TM #4 — Fresh-Concrete Testing Procedures (Continued)

      e. TM #5 — Fresh-Concrete Sampling Procedures

      f. TM #6 — Fresh-Concrete Sampling Procedures (Continued)

  C. Information sheet

  D. Assignment Sheet #1 — Read and Interpret Specifications Pertaining to Concrete

  E. Answers to assignment sheet

  F. Job sheets

    1. Job Sheet #1 — Obtain Representative Fresh-Concrete Test Samples (ASTM C 172-82)

    2. Job Sheet #2 — Perform a Slump Test (ASTM C 143-78)

    3. Job Sheet #3 — Make a Cylinder-Mold Test Specimen (ASTM C 31-84)

    4. Job Sheet #4 — Make a Beam-Mold Test Specimen (ASTM C 31-84)

    5. Job Sheet #5 — Perform Volumetric-Method Air-Content Test (ASTM C 173-78)

    6. Job Sheet #6 — Use Type-B Air Meter to Perform Pressure-Method Air-Content Test (ASTM C 231-82^{E1})

    7. Job Sheet #7 — Perform Temperature Test

    8. Job Sheet #8 — Perform Unit-Weight Test (ASTM C 29-78^{E2})

SUGGESTED ACTIVITIES

- G. Test
- H. Answers to test

II. Instructor's guide

- A. Review unit and plan presentation.
- B. Obtain materials to supplement unit.
    1. Videocassette training tape — *Field Testing for Concrete, Field Testing Technician—Grade I.* Color, 55 minutes, Portland Cement Association/American Concrete Institute, n.d. Available from the Portland Cement Association, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077, or from the American Concrete Institute, P.O. Box 19159, Redford Station, Detroit, Michigan 48219.
    2. Complete set of plans, including drawings and specifications
    3. Newest edition of the *Annual Book of ASTM Standards*
    4. Copies of Supplement #1
    5. Equipment needed to complete job sheets
    6. Transparencies and competency profiles

       (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of American, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)
- C. Introduce unit to students.

  SUGGESTIONS:

    - To introduce students to specifications, show them the complete set of specifications you have collected, and explain the various sections, stressing the format of the specifications section.
    - Show the Portland Cement Association/American Concrete Institute videocassette *Field Testing for Concrete, Field Testing Technician—Grade I.*
    - Take students to a testing laboratory to view testing procedures done on hardened-concrete samples.
- D. Provide students with objective sheet.
- E. Discuss unit and specific objectives.

SUGGESTED ACTIVITIES

F. Provide students with information, assignment, and job sheets.

G. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with specifications and testing.

   SUGGESTIONS:

   - Have students review terms and definitions.
   - Show students samples of terms if appropriate.
   - Explain to students that understanding these terms and definitions will help them better understand this unit.

2. Use Information Sheet, Sections II and III, to discuss the reasons concrete masons read specifications and concrete-related factors included in specifications.

   SUGGESTIONS:

   - Review and further explain the definition of *specifications*. Explain to students that specifications are also called *specs*.
   - Show students the complete set of plans you have collected and explain how the specifications supplement the drawings in a set of plans and provide complete descriptions concerning methods of construction, complete descriptions of standards of construction, and a complete listing of the materials to be used during construction.
   - Explain to students that it would be unusual that they would see identical sets of specifications because architects develop their own formats for presenting information and every job has different construction requirements.
   - Take students on a field trip to some of the architectural offices in your area so that the students will have the opportunity to see the different formats and factors that are included in various types of specifications.
   - Have students look at the specifications pertaining to concrete that are provided in Assignment Sheet #1, "Read and Interpret Specifications Pertaining to Concrete." Point out that this is not a complete set of specifications, but only those sections that would pertain to concrete. Read the specifications to students and discuss any terms that students are not familiar with. Have students complete Assignment Sheet #1.

3. Use Information Sheet, Section IV, to discuss the descriptions of fresh-concrete and hardened-concrete sampling and testing procedures commonly performed by concrete masons.

SUGGESTED ACTIVITIES

SUGGESTIONS:

- When discussing the sampling and testing procedures commonly performed by concrete masons, show students the actual equipment they will be using in conducting the procedures, or use Transparencies #1 through #6 to supplement your discussion.
- Hand out copies of Supplement #1, "Typical Test Form," and discuss its use in industry.
- Discuss with students the procedures presented in Job Sheets #1 through #8. Use the latest edition of the *Annual Book of ASTM Standards* to reinforce and update your discussion of these various procedures. Stress the importance of accuracy when conducting these procedures.
- Discuss procedures used to assure accuracy in obtaining representative test samples:

  —Procedure should be performed in as short a time as possible, but in no instance shall it exceed fifteen minutes.

  —Do not obtain samples from the very first or last portions of the batch discharge.

  —Minimum composite size for tests is 1 cubic foot.

  —Protect samples from sun, wind, and other sources of rapid evaporation and from contamination during the period between the gathering of sample portions and the test.
- Caution students that testing procedures should begin within five minutes after representative test samples has been obtained.
- Have students complete Job Sheets #1 through #8.
- You may also want to discuss with students some of the other types of tests that are performed on concrete and on the aggregates used in concrete.

  EXAMPLES: Test methods for unit weight and voids in aggregate, test methods for organic impurities in fine aggregates in concrete, test methods for cement content of hardened portland cement concrete, test methods for bleeding of concrete.

H. Review information.

I. Give test.

J. Critique test and discuss in class.

K. Reteach and retest if necessary.

SUGGESTED ACTIVITIES

L. Complete appropriate section of competency profiles.

III. Unit references

A. *Annual Book of ASTM Standards—Section 4: Construction, Volume 04.02 Concrete and Mineral Aggregates*. Philadelphia, Pennsylvania: American Society for Testing and Materials, 1985.

B. *Cement and Concrete Terminology*, Publication SP-19 (85) AC 1 116R-85. Detroit, Michigan: American Concrete Institute, 1985.

C. *Concrete Performance Data Handbook*. Cleveland, Ohio: Master Builders, Division of Martin Marietta Corporation, 1983.

D. *Design and Control of Concrete Mixtures*, 12th ed. Skokie, Illinois: Portland Cement Association, 1979.

E. Hendrix, Laborn J. "Bud." *Cement Mason Curriculum*. Stillwater, Oklahoma; State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1975.

F. *Testing Apparatus and Supplies*, supplemental catalog. Wampum, Pennsylvania: Forney Inc., 1986.

SUPPLEMENT #1 — TYPICAL TEST FORM

REPORT CONCRETE CYLINDER ____________ Date Cast ____________
Structure Project ____________ Specification ____________
Station Location ____________ Quantity Represented ____________
Architect Engineer ____________ Sampled by ____________
Contractor ____________ by Order of ____________
Reported to ____________ Date ______ Order Number ____________

TEST RESULTS Laboratory Number

Field Number

Compressive Strength, Lbs.				
Age When Tested, Days				
Compressive Strength, Lbs./Sq. In.				

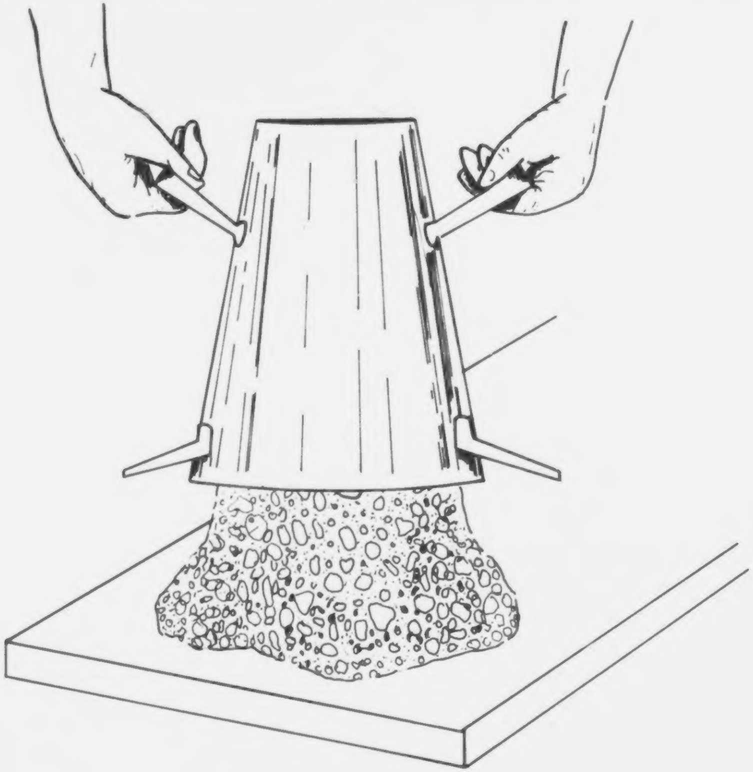
Average Strength, Lbs./Sq. In.
Method of Curing Field Days, Laboratory from Transported by

Temperature: Ambient °F; Mix °F Entrained Air % Slump Inches

Source of Concrete Code. Time or Tkt. Number
Material
Fine Aggregate Lbs.
Coarse Aggregate Lbs.
Water Gal.
Cement Sacks/Yard
Admixture
Remarks:
Specimens 6" Dia. × 12" 28.3 Sq. In. Cross Section, Defects as Noted
Type Break, Conical

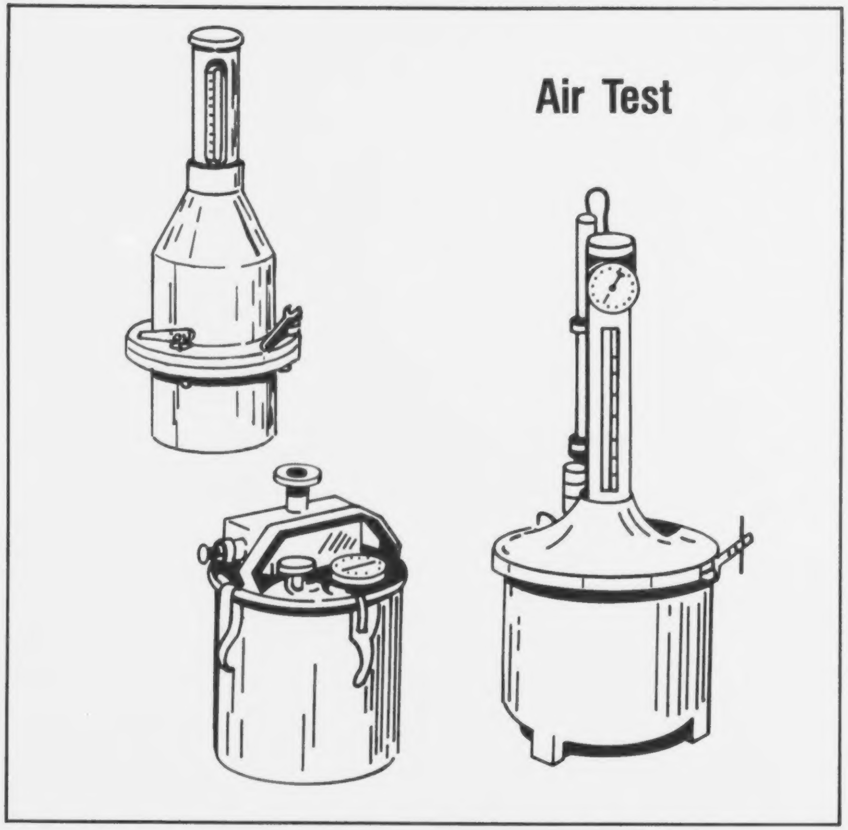
Date Tested				
Diameter Length				
Type Break				

Fresh-Concrete Testing Procedures



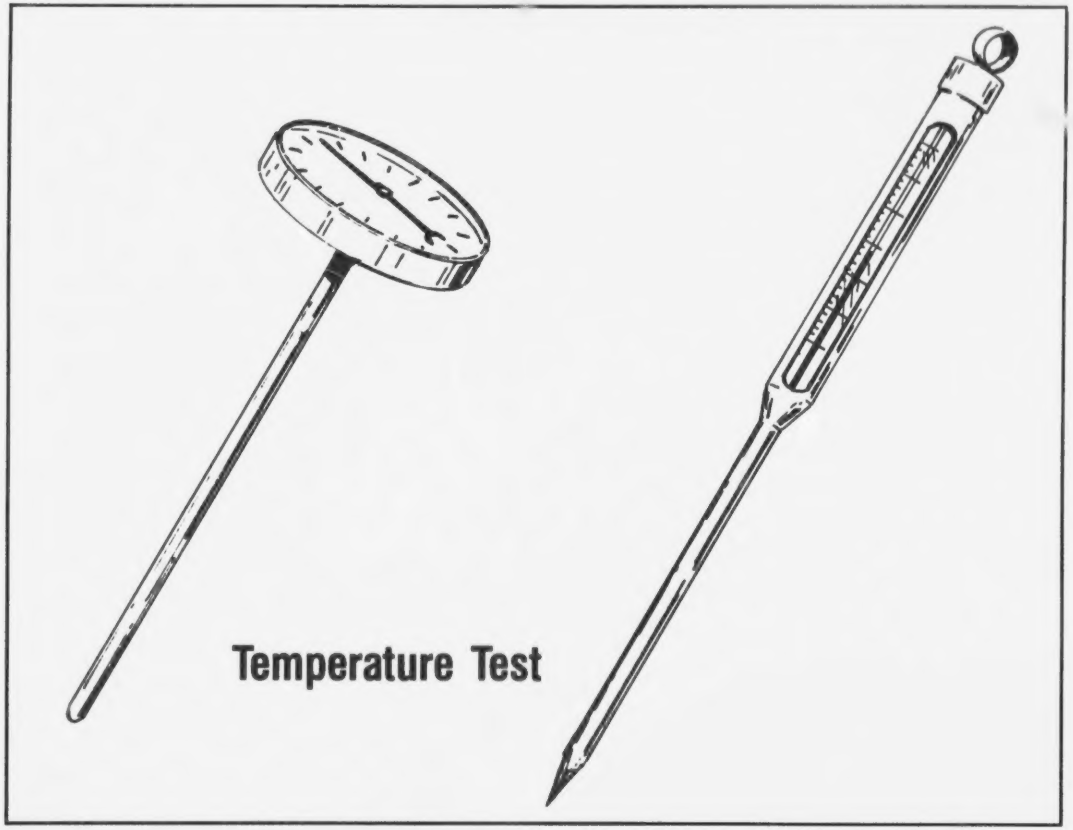
Slump Test

Fresh-Concrete Testing Procedures
(Continued)



Fresh-Concrete Testing Procedures

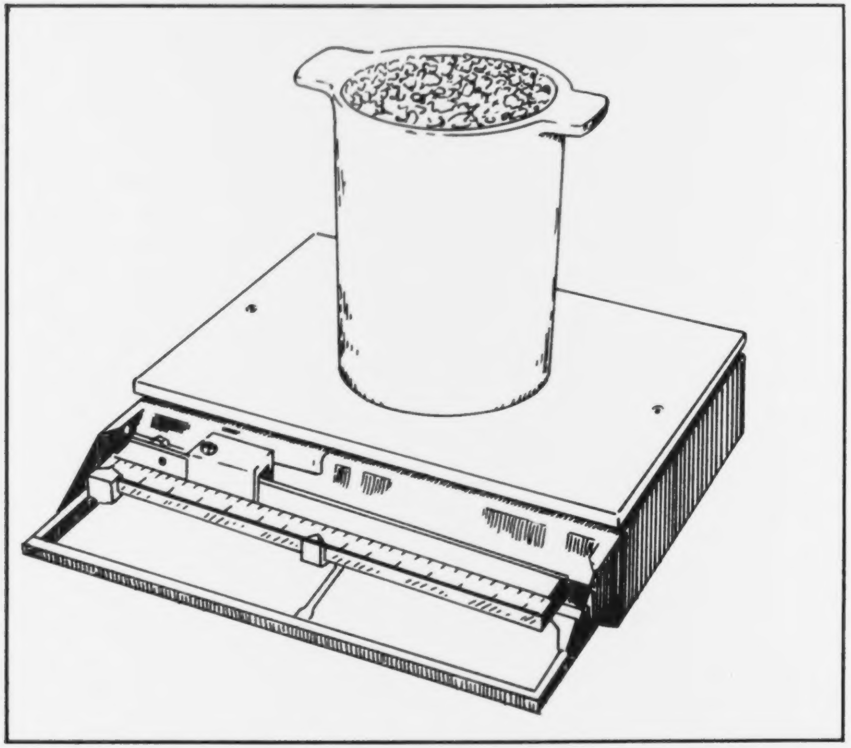
(Continued)



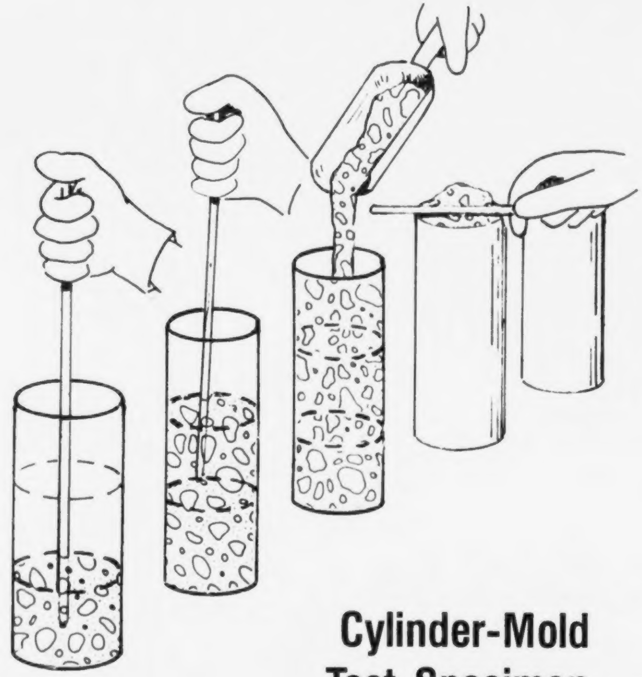
Temperature Test

Fresh-Concrete Testing Procedures
(Continued)

Unit-Weight Test

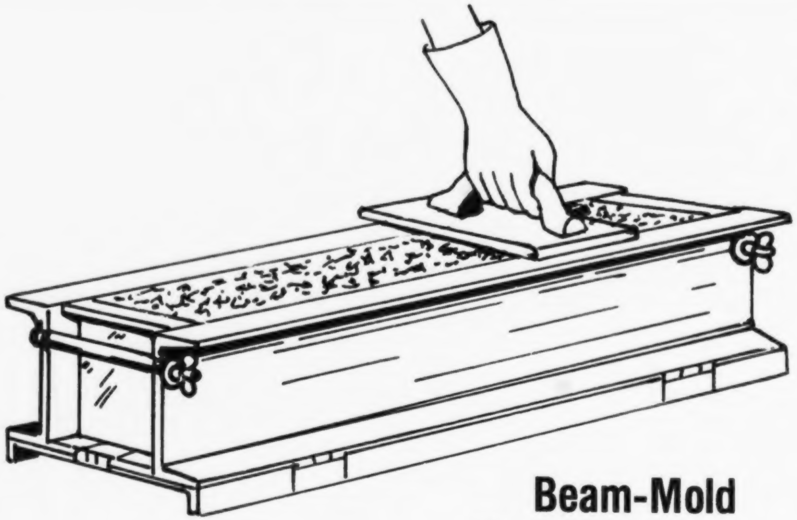


Fresh-Concrete Sampling Procedures



Cylinder-Mold Test Specimen

Fresh-Concrete Sampling Procedures
(Continued)



Beam-Mold
Test Specimen

SPECIFICATIONS AND TESTING
UNIT IV

INFORMATION SHEET

I. Terms and definitions associated with specifications and testing

A. Factor — Item that pertains to accomplishing the finished product

EXAMPLES: Dimension, tolerance, color, finish

B. Specifications — Detailed set of written instructions that supplements the drawings in a set of plans, describes equipment and materials used in the structure, and becomes part of the contract

C. Dimensions — Conventional lines and figures used to indicate actual sizes and distances of objects and spaces represented on plans

D. Tolerance — Acceptable variance from standard

E. Slump — Measure of the consistency of freshly mixed concrete

F. Consistency — Relative ability of freshly mixed concrete to flow

G. American Concrete Institute (ACI) — Nonprofit membership organization dedicated to public service and to representing users' interests in the field of concrete

H. Segregate — To separate

I. Grout — Mixture of cementitious materials and water proportioned to produce a pourable consistency without segregation of components

II. Reasons concrete masons read specifications

A. To obtain supplemental information drawings alone cannot provide

(NOTE: Written specifications are equally as important as the drawings in a set of plans. They furnish what the drawings cannot, in that they give detailed and accurate written descriptions of the work to be done.)

B. To obtain complete descriptions concerning methods of construction

C. To obtain complete descriptions of standards of construction

EXAMPLES: Tolerances allowed; quality, type, and sizes of materials and equipment to be used

D. To obtain a complete listing of the quantity of materials to be used during construction

INFORMATION SHEET

III. Concrete-related factors included in specifications

A. Type and quality of materials to be used

EXAMPLES: Type and strength of concrete; type of reinforcing steel

B. Dimensions of concrete components to be constructed

C. Dimensions of materials to be used

D. Construction methods required

E. Tolerances allowed

F. Maximum water/cement ratio allowed in concrete

G. Percentage of air required in concrete

H. Slump required for concrete

I. Concrete finishes required

J. Types and methods of concrete curing required

K. Types of concrete tests required

IV. Descriptions of fresh-concrete and hardened-concrete sampling and testing procedures commonly performed by concrete masons

A. Fresh-concrete sampling and testing procedures

(NOTE: The following list includes the types of samples and tests commonly performed by concrete masons on plastic [fresh] concrete. A knowledge of these procedures greatly benefits the concrete mason. The American Society for Testing and Materials [ASTM] has standardized concrete sampling and testing procedures. All sampling and testing procedures concrete masons conduct must be made in accordance with ASTM standards.)

1. Sampling (ASTM C 172-82) — Procedure to obtain representative composite samples of fresh concrete from stationary and paving mixers, truck mixers, agitators, and dump trucks

2. Slump test (ASTM C 143-78) — Procedure completed at job site to obtain a molded sample used as a rough measure of the consistency of fresh concrete

   (NOTE: The slump test measures how wet or dry the fresh concrete is; it is *not* a measure of workability or proper water content.)

3. Cylinder molding (ASTM C 31-84) — Procedure completed at job site to obtain concrete sample to be cured and used later in laboratory compression tests

   (NOTE: Compression tests measure concrete strength gain and the effectiveness of job-site curing.)

4. Beam molding (ASTM C 31-84) — Procedure completed at job site to obtain a concrete sample to be used later in laboratory flexural-strength tests

   (NOTE: Flexural-strength tests determine the bending strength of concrete.)

INFORMATION SHEET

5. Air-content test — Procedure completed at job site to obtain a measure of air content in concrete

   (NOTE: Various methods are used to obtain an air-content measurement. The two methods presented later in this unit are the volumetric method [ASTM C 173-78] and the pressure method using a Type-B air meter [ASTM C 231-82^{E1}].)

6. Temperature test — Procedure completed at job site to check internal temperature of fresh concrete

7. Unit-weight test (ASTM C 29-78^{E2}) — Procedure completed at job site to measure cubic-foot weight of fresh concrete

B. Hardened-concrete sampling and testing procedures

1. Core sampling — Procedure completed at job site to obtain a hardened-concrete sample to be used later in compression tests

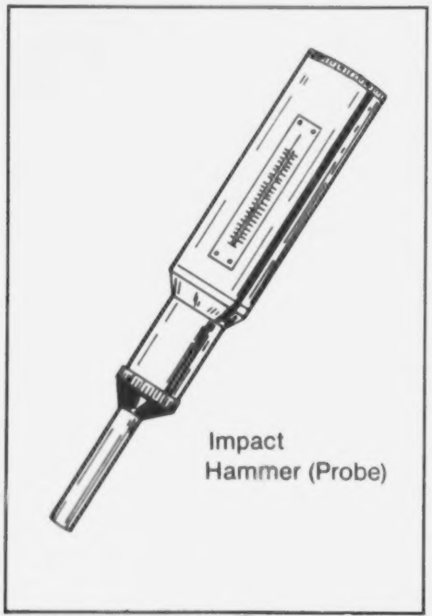
   (NOTE: A core sample is made with a core drill or a coring machine.)

2. Impact test (hammer test, probe test) — Procedure performed at job site on hardened, in-place concrete to determine when forms can be removed or when loads can be applied to structure

   (NOTE: An impact test is made by placing the impact plunger of a hammer [probe] against the surface of the concrete and then pressing until the hammer releases and records the rebound value. See Figure 1.)

   EXAMPLE:

FIGURE 1



SPECIFICATIONS AND TESTING
UNIT IV

ASSIGNMENT SHEET #1 — READ AND INTERPRET SPECIFICATIONS PERTAINING TO CONCRETE

NAME ______________________________ SCORE ______________

Concrete masons must be able to read and interpret the written specifications included in a set of plans. Written specifications supplement the drawings in a set of plans and provide concrete masons with vital information concerning the methods they are to use, the standards they are to meet, and the quality and quantities of materials they are to use in the construction of a structure. Without the vital information contained in the specifications concrete masons cannot perform their jobs.

At first, the language and format used for written specifications may seem difficult to understand, but with practice, specifications become less and less difficult to read and interpret. The following assignment will provide you with the practice you will need to read and interpret those portions of a sample set of specifications that pertain to concrete. Read the specifications on the following pages, and then answer each of the items below. Please note that this is not a complete set of specifications; only the index and the specifications pertaining to concrete have been reproduced here.

A. List the three chemical admixtures that will be used in the concrete on this job.

1. ______________________________

2. ______________________________

3. ______________________________

B. Name the two types of grouts that will be used on this job.

1. ______________________________

2. ______________________________

C. Name the material that will be used as a vapor barrier. ______________

D. State the slump range specified for concrete used for sidewalks. ______________

E. State the number of test cylinders that will be made for sidewalk pours of more than 4 cubic yards.

____

F. State the brand name of the curing solution to be used on concrete floors.

____

ASSIGNMENT SHEET #1

G. List three types of concrete specified for this structure.

1. ______________________________
2. ______________________________
3. ______________________________

H. State the tolerance specified for a finished slab. ______________________________

I. Name the type of finish specified for slabs. ______________________________

____

ASSIGNMENT SHEET #1

Sample Specifications

INDEX

Schedule of Drawings SD-1

Proposal for the General Contract . . . . .A - B

Instructions to Bidders (Printed Form) . . . . .1 - 3

General Conditions of the Contract for Construction (Printed Form) . . . . .1 - 18

Supplementary General Conditions . . . . .SC-1 - SC-2

Applications for Payment AP-1

I. **GENERAL REQUIREMENTS**

General Requirements . . . . .1A-1 - 1A-4

II. **SITE WORK**

Demolition 2A-1
Excavating, Filling, Grading . . . . .2B-1 - 2B-2
Bituminous Paving . . . . .2C-1 - 2C-2

III. **CONCRETE**

Concrete Work . . . . .3A-1 - 3A-5
Gypsum Roof Decks . . . . .3B-1 - 3B-2

IV. **MASONRY**

Masonry . . . . .4A-1 - 4A-3

V. **METALS**

Structural Steel . . . . .5A-1 - 5A-2
Sundry Iron and Steel . . . . .5B-1 - 5B-2

VI. **CARPENTRY**

Carpentry and Millwork . . . . .6A-1 - 6A-3

VII. **MOISTURE PROTECTION**

Roofing . . . . .7A-1 - 7A-3
Sheet Metal 7B-1
Caulking 7C-1
Dampproofing 7D-1

VIII. **DOORS, WINDOWS, AND GLASS**

Aluminum Windows 8A-1
Hollow Metal Doors, Frames, and Trim 8B-1
Glass and Glazing 8C-1
Finish Hardware . . . . .8D-1 - 8D-3

ASSIGNMENT SHEET #1

INDEX (Cont.)

IX. **FINISHES**

Acoustical Tile 9A-1
Resilient Floor Tile 9B-1
Painting . . . . 9C-1 - 9C-3
Special Plastic Coating 9D-1
Seamless Flooring 9E-1
Lathing and Plastering . . . . 9F-1 - 9F-2
Exposed-Aggregate Facing 9G-1

X. **SPECIALITIES**

Toilet Compartments . . . . 10A-1 - 10A-2

XIV. **CONVEYING SYSTEM**

Hydraulic Elevator . . . . 14A-1 - 14A-2

XV. **PLUMBING AND HEATING**

Plumbing and Heating . . . . 15A-1 - 15A-2

XVI. **ELECTRICAL**

Electrical 16A

DIVISIONS XI, XII, & XIII NOT USED

ASSIGNMENT SHEET #1

CONCRETE WORK

1. GENERAL NOTES:

(A) See drawings, schedules, and details for type and location of concrete work required.

(B) Inserts and pipe sleeves for mechanical and electrical work are included under mechanical divisions of the specifications.

(C) Anchor bolts for wood, steel, etc., are included under their respective headings.

2. MATERIALS:

(A) *Portland Cement:* ASTM C 150-85 and use Type I or IA for all concrete work.

(B) *Coarse Aggregate:* Hard, durable, uncoated crushed stone or gravel conforming to ASTM C 33-85 latest specification.

(C) *Sand:* Clean, hard, durable, uncoated grains free from salt, lignite, loam, and clay, to conform to ASTM C 33-85 latest edition.

(D) *Chemical Admixtures:* Shall be equal to Pozzolith® normal-setting admixture conforming to ASTM C 494-82, Pozzolith® retarding admixture conforming to ASTM C 494-82, "Master Builders" air-entraining admixture conforming to ASTM C 260-77.

(E) *Mixing Water:* Clean and free from oil, acid, and injurious amounts of vegetable matter, alkalies, and other salts (drinkable water).

(F) *Reinforcing Steel:* Shall conform to ASTM Standard A 615, Grade 60. Metal shall be clean and free from excessive rust, scale, or coatings that will reduce bond.

(G) *Steel Welded-Wire-Fabric Reinforcement:* Shall conform to ASTM A 185-61T. Steel wire spot-welded at intersections and of size and spacing indicated. Welded wire fabric shall be overlapped wherever successive mats or rolls are continuous in such a way that the measured distance between outermost cross wires is not less than one spacing plus 2 inches. Where size and spacing are not designated, use 6 × 6 — W1. 4 × W1. 4 welded wire fabric.

(H) *Metal Accessories:* Include all spacers, chairs, ties, and other devices necessary for properly placing, spacing, supporting, and fastening reinforcement in place.

(I) *Expansion-Joint Filler:* Asphalt-impregnated fiberboard conforming to ASTM D 1751-83. Joint material shall be full thickness of slab or joint and, unless otherwise indicated, 1/2 inch thick.

(J) *Grout:* Bearing-plate and column-base-plate grout shall be Sonneborn Co. "Ferrolith" or Master Builders Embeco®—636 nonshrink grout, conforming to ASTM C 931-81.

ASSIGNMENT SHEET #1

CONCRETE WORK (Cont.)

(K) *Vapor Barrier:* Under all concrete slabs on grade to be 6 mil polyethylene film, placed over leveled subgrade immediately before placing concrete. Lap all edges a minimum of 6 inches.

3. **FORMS:** Where concrete will be exposed, use moisture-resistant plywood forms. Sheets shall be as large as possible with smooth, even edges and installed with close joints. Joint marks and fins shall be smoothed off and surfaces left smooth, dense, and free from honeycombing, prominent grain marking, and bulges or depressions.

4. **CONSTRUCTION OF FORMS:** Construct forms to slopes, lines, and dimensions shown, plumb and straight and sufficiently tight to prevent leakage; securely brace and shore forms to prevent displacement and to safely support construction loads. Provide access openings to clean and inspect forms and reinforcing prior to depositing concrete. Do not coat forms with material that will stain or cause injury to exposed concrete surfaces. Construct forms for beams, girders, and lintels so that sides may be removed without disturbing bottom of form or its support.

5. **PLACING REINFORCEMENT:** Place reinforcement accurately in position shown; securely fasten and support to prevent displacement before or during placing. Allow time for inspection before placing concrete.

6. **INSERTS AND FASTENING DEVICES FOR OTHER WORK:**

(A) Provide for installation of inserts, hangers, metal ties, anchors, bolts, angle guards, stair nosings, dowels, thimbles, slots, nailing strips, blocking grounds, and other fastening devices required for attachment of other work. Properly locate in cooperation with other trades and secure in position before concrete is placed. Do not install sleeves in any concrete beams, joists, or columns except upon approval of the architect.

(B) Where concrete walls, columns, or beams more than 16 inches in height are veneered with masonry, build metal anchor slots into concrete; space inserts not over 3 feet apart horizontally.

7. **CONCRETE:**

(A) The working stresses from the design of this structure are based on the concrete's having minimum compressive strength of 3000# at the end of a 28-day period, unless otherwise noted. Only enough water is to be used so as to produce a concrete within the following consistency range in slump. Use the lowest slump compatible with proper placing: foundation walls and footings 2 to 5 inches, slabs, beams, and columns 3 to 5 inches, slabs on ground and pavement 2 to 4 inches. When a chemical admixture is used, reduce the amount of water to stay within the slump specified.

(B) Concrete for walks and platforms shall contain an air-entraining agent conforming to "Specifications for Air-Entraining Admixtures for Concrete"(ASTM C 260-77). Amount of air shall be 5% minimum and 7% maximum.

(C) No salt, chemical, dust, or other foreign material shall be added to the concrete mixture to prevent freezing or for any other purpose except chemical admixtures previously specified.

ASSIGNMENT SHEET #1

CONCRETE WORK (Cont.)

(D) The architect shall have the right to make any change in proportion of materials that may be necessary or desirable. Proper adjustments or compensation will be made in accordance with the provisions of the contract.

(E) All concrete work shall conform to all requirements of ACI 318, "Building Code Requirements for Reinforced Concrete," and ACI 301, "Specifications for Structural Concrete for Buildings" except as modified by supplemental requirements.

8. **MEASURING:** The method of measuring water and aggregate shall be such as to secure specified proportion in each batch and in manner that proportion of water to cement can be closely controlled and easily checked at any time.

9. **MIXING CONCRETE:** Ready-mixed concrete shall be delivered to the site according to standards set forth by ASTM C 94-84. Contractor shall see that a sufficient quantity of concrete is provided to rapidly carry on the work. No retempering of partially hardened concrete will be permitted. Concrete shall be mixed no longer than 1 1/2 hours or 300 revolutions before discharge.

10. **CONSTRUCTION CONTROL TESTS:**

(A) Four standard 6" × 12" cylinders shall be made for each pour of more than 10 cubic yards or for each 50 cubic yards of concrete, except that for slabs or walks on grade when four cylinders shall be made for each pour of more than 4 cubic yards, or for each 20 cubic yards of concrete. Two cylinders shall be crushed at 7 days, and the other two at 28 days.

(B) The contractor shall employ and pay for the services of a testing laboratory to test the compression cylinders and check the materials to determine compliance with specification requirements. All tests shall be made in accordance with ASTM standards. The contractor shall properly make or have lab make and properly deliver the cylinders to the laboratory for testing and shall properly identify the locations of the pours to which the cylinders refer. Submit copies in triplicate of laboratory test reports to the architect during progress of the construction.

(C) In all cases where the average strength of the laboratory control cylinder shown by these tests for any portion of the structure falls below the minimum ultimate compressive strength called for on the plans, the architect shall have the right to order a change in the mix or in the water content for the remaining portion of the structure. In cases where the average strength of the cylinders cured on the job falls below the required strength, the architect shall have the right to require conditions of temperature and moisture necessary to secure the required strength and may require load tests to be made on the portions of the building so affected.

ASSIGNMENT SHEET #1

CONCRETE WORK (Cont.)

11. **PLACING CONCRETE:**

(A) Place no concrete until foundations, forms, reinforcing steel, pipes, conduits, sleeves, hangers, anchors, inserts, waterproofing, and other work required to be built into concrete have been inspected and approved by the architect. Before pouring footings or foundations, see that bottoms of excavations are undisturbed earth, properly leveled off.

(B) All concrete shall be mechanically vibrated to prevent honeycombing, using internal vibrators of proper size. Vibration shall be concentrated vertically when consolidating the concrete. Do not use vibration to move concrete laterally.

(C) No work shall be done at temperatures below 40 degrees unless weathertight enclosures and artificial heat are used.

12. **FINISH OF ROUGH STRUCTURAL SLABS:** Slab surfaces, except where integral cement finish is required, shall be thoroughly raked or wire broomed to provide bond for other finishes.

13. **REMOVAL OF FORMS:** Remove forms only with consent of the architect, without damage to concrete, and in a manner to ensure complete safety of the structure. Leave shoring in place until concrete member will safely support its weight and the loads upon it.

14. **PATCHING:** Directly after forms have been removed, all exposed tie wires and stapled ends shall be removed from concrete surfaces to be exposed; cut ties flush with finished surfaces of all other concrete and fill honeycombing surfaces, stone pockets, and other irregularities with cement mortar, rubbing same to uniform surface.

15. **ARCHITECTURAL CONCRETE:** Exposed concrete surfaces shall be rubbed to a smooth and uniform surface with cement mortar immediately upon removing forms.

16. **PROTECTION AND CURING:**

(A) Protect concrete against frost and rapid drying and keep moist for at least 6 days after placing. Concrete from which forms are removed within 6 days after pouring and concrete finishes shall be sprayed during the curing period as frequently as drying conditions may require and shall be protected by suitable temporary covering.

(B) Floors shall be sprayed with "Demicon Cure-Hard" solution as per manufacturer's recommendations. Solution shall be tinted to make coverage visible. Floors may be cured by covering with a plastic film of at least 3-mil thickness.

17. **GRAVEL OR CRUSHED ROCK:** Shall be 4 inches thick, placed under all slabs on grade except walks. Well tamped to firm, even surface. Gravel to be C gravel. Crushed rock to be minimum 3/4 inch.

ASSIGNMENT SHEET #1

CONCRETE WORK (Cont.)

18. **FLOOR SLABS:**

(A) In general, concrete interior floor slabs on earth shall have integral finish, 6×6-W1.4×W1.4 reinforcing, and be 4 inches thick unless otherwise noted.

(B) Where floor slabs are to remain exposed, with no other finish applied, take special care to protect slabs from staining, chipping, and abrasion.

19. **CONCRETE FINISHING:** After concrete slab has been properly struck off and darbied or bull floated and when water sheen has disappeared and/or mix has sufficiently stiffened, begin floating operation. Both power and hand troweling shall be required. Continue troweling until surface is dense, smooth, and free of all blemishes. Final hand troweling shall be used to remove imperfections left by machine troweling and to bring surface to a dense, polished finish. Continue on until trowel passing over surface causes ringing sound. No spreading of cement over slab to absorb moisture will be allowed. Finished slab is to vary no more than 1/8 inch in 10 feet when tested with a 10-foot-long straightedge. If variations greater than this exist, the architect may direct the contractor to grind the floor to bring the surface within the requirements. Patching of low spots will not be permitted. Slabs shall be leveled with the use of pipe screeds or "wet pads" leveled with an instrument.

20. **PLATFORM:** Shall have 6×6-W1.4×W1.4 reinforcing and shall be jointed as shown. Shall have aluminum floated integral concrete finish; exposed vertical surfaces shall be formed with plywood for a smooth finish. To be 4 inches thick, and have a pitch of 1/4" to 1'-0", unless otherwise noted. Finish edges with edging tools.

21. **UNIT PRICES:**This contractor shall state in his/her bid to the general contractor the unit prices as listed below. These prices shall be used as a basis for adjusting the contract price for extras or credits:

(A) Price per cubic yard for additional concrete in place $____________
(B) Price per square foot for additional form work $____________
(C) Price per pound of additional reinforcing steel in place $____________

22. **SHOP DRAWINGS:** Reinforcing-steel placing drawings and bar lists shall be prepared in accordance with ACI standards by the structural engineer, *Bergmeir, Siebold & Sydow, Inc.*, Crestwood Bank Building, 9705 Highway 66, St. Louis, MO 63126. The cost of this work shall be included in the contract price based upon standard published rates and estimated reinforcing-bar tonnage.

ASSIGNMENT SHEET #1

GYPSUM ROOF DECKS

1. **SCOPE:**

The contractor shall furnish all labor, material, and equipment to complete the installation of the poured gypsum concrete roof decks, together with cants, curbs, and drainage fills as shown and specified. Approved shop drawings are required before work proceeds. Provide temporary walkways as necessary to handle materials.

2. **MATERIALS:**

(A) Subpurlin — Steel subpurlins shall be special section bulb tees of proper weight and section to support the required dead and live loads. They shall be shop-painted with one coat of approved paint.

(B) Formboards shall be:

1. ¾-inch Fiberglass formboard in lengths equal to main purlin spacings. Where end joints do not occur on main purlins, painted sheet-metal tees are required to support end joints.

(C) Reinforcing fabric shall be:

1. Welded galvanized wire fabric equivalent to No.-12-gauge longitudinal wires spaced 4 inches on centers and No.-14-gauge transverse wire spaced not over 8 inches on centers; or

2. An approved equivalent type fabric having an effective cross-sectional area of not less than 0.026 sq. in. per foot of slab width; or

3. A galvanized wire reinforcement having a minimum tensile strength of 70,000 psi—2-inch hexagonal mesh of No.-19-gauge and No.-16-gauge wires woven longitudinally every 3 inches across face of the fabric.

(D) Gypsum concrete shall be U.S. Gypsum's Thermofill. Only clean water shall be added on the job.

3. **INSTALLATION:**

(A) Subpurlins shall be placed to fit formboard widths and welded to each main purlin using a fillet weld (½-inch minimum) placed on alternate sides of subpurlins.

(B) Formboards shall be placed on subpurlin flanges with all end or cross joints supported by main purlins or special cross-tees. Formboard shall be cut to fit neatly at walls, curbs, and openings as required.

ASSIGNMENT SHEET #1

GYPSUM ROOF DECKS (Cont.)

(C) Reinforcing fabric shall be laid with the No.-12-gauge wire at right angles to the subpurlins. Lap ends of fabric not less than 6 inches. Sides of fabric shall not be lapped. Cut fabric to fit at walls, curbs, and openings, and carry fabric into all areas where gypsum concrete is to be placed.

(D) Gypsum concrete shall be mixed only with clean water at the job and poured in place over the forms and reinforcing to an average thickness of not less than 2 inches (2¼ inches over asbestos cement formboards). Screed all surfaces to a smooth, even plane ready to receive roof covering. Pour cants, curbs, and drainage fills as shown or required. After the slab has been poured, roof shall be left free and clean for other trades.

SPECIFICATIONS AND TESTING
UNIT IV

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

A. 1. Pozzolith® normal-setting admixture
   2. Pozzolith® retarding admixture
   3. Master Builders air-entraining admixture

B. 1. Sonneborn Co. Ferrolith grout
   2. Master Builders Embeco-636 nonshrink grout

C. 6-mil polyethylene film

D. 2 to 4 inches

E. Four

F. Demicon Cure-Hard

G. 1. Type I portland cement
   2. Type IA portland cement
   3. US Gypsum's Thermofill

H. 1/8 inch in 10 feet

I. Hand-troweled, polished finish

SPECIFICATIONS AND TESTING
UNIT IV

JOB SHEET #1 — OBTAIN REPRESENTATIVE FRESH-CONCRETE TEST SAMPLES (ASTM C 172-82)

I. Tools and materials

A. Sampling and mixing containers

(NOTE: The containers must be suitable heavy-gauge metal pans; wheelbarrows; or flat, clean, nonabsorbent mixing boards.)

B. Shovels

C. Hand scoops

D. Plastering trowels

E. Rubber gloves and protective clothing

> **CAUTION**
>
> Always wear rubber gloves and protective clothing when working with fresh concrete.

F. Concrete

II. **Procedure for sampling from stationary mixers (except paving mixers)**

A. At regularly spaced intervals during discharge of the *middle* portion of batch, take two or more sample portions, using one of the following methods

1. Repeatedly pass sampling container through entire discharge stream, *or*
2. Completely divert discharge stream into sampling container

B. Collect sample portions into mixing container to produce composite sample

C. Transport composite sample to test location

D. Using shovel, combine and remix composite sample just enough to ensure mix uniformity

E. Begin testing

III. **Procedure for sampling from paving mixers**

A. After the contents of the paving mixer have been discharged, take sample portions from at least *five* different areas of the pile

> **CAUTION**
>
> Avoid contamination with subgrade material or prolonged contact with absorptive subgrade.

B. Collect sample portions into mixing container to produce composite sample

C. Transport composite sample to test location

D. Using shovel, combine and remix composite sample just enough to ensure mix uniformity

E. Begin testing

IV. **Procedure for sampling from revolving-drum truck mixers or agitators**

A. At regularly spaced intervals during discharge of the *middle* portion of batch, take two or more sample portions, using one of the following methods

> **CAUTION**
>
> *Do not* obtain samples until after all of the water has been added to mixer.

1. Repeatedly pass sampling container through entire discharge stream, *or*
2. Completely divert discharge stream into sampling container

B. Collect sample portions into mixing container to produce composite sample

C. Transport composite sample to test location

D. Using shovel, combine and remix composite sample just enough to ensure mix uniformity

E. Begin testing

V. **Procedure for sampling from open-top truck mixers, agitators, nonagitating equipment, or other types of open-top containers**

A. Collect sample portions following procedure in Step II A, Step III A, or Step IV A, whichever procedure is most applicable under the given conditions

B. Collect sample portions into mixing container to produce composite sample

C. Transport composite sample to test location

D. Using shovel, combine and remix composite sample just enough to ensure mix uniformity

E. Begin testing

SPECIFICATIONS AND TESTING
UNIT IV

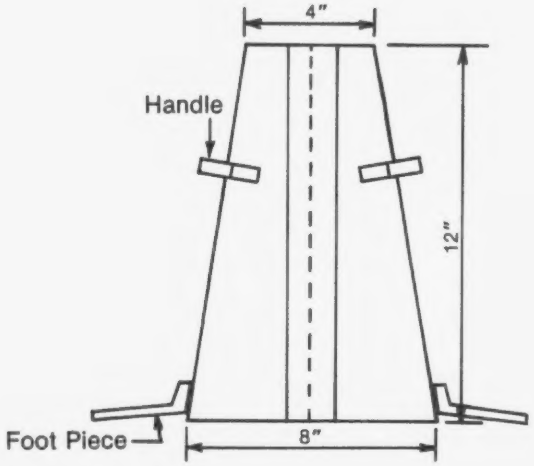
JOB SHEET #2 — PERFORM A SLUMP TEST (ASTM C 143-78)

I. Tools and materials

A. Standard slump cone

(NOTE: Made of galvanized metal, the standard slump cone is 8 inches in diameter at the base, 4 inches in diameter at the top, and 12 inches high. The base and top are open, and the cone has foot pieces and handles. See Figure 2.)

FIGURE 2



B. Tamping rod

(NOTE: The tamping rod for this test is a smooth, $^{5}/_{8}$-inch-by-24-inch, bullet-nosed [hemispherical-tipped] steel rod.)

C. Scoop or trowel

D. Rule

E. Clean, firm, level, nonabsorbent test surface

EXAMPLES: Smooth plank, concrete slab

F. Container of water

JOB SHEET #2

G. Rubber gloves and protective clothing

CAUTION

Always wear rubber gloves and protective clothing when working with fresh concrete.

H. Pencil

I. Chart for recording test results

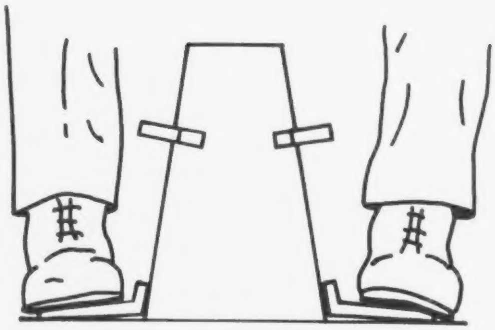
II. Procedure

A. Obtain representative concrete test sample (See Job Sheet #1)

B. Dampen slump cone and test surface with water

C. Place slump cone base down on test surface, and stand on cone's foot pieces to hold cone firmly in place (Figure 3)

FIGURE 3



CAUTION

Steps D through L should be completed in about 2 1/2 minutes.

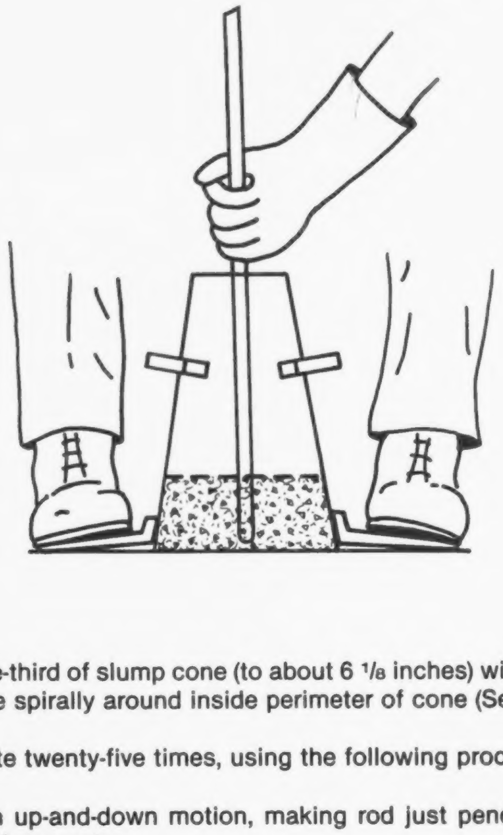
JOB SHEET #2

D. Fill slump cone with concrete to about one-third cone's capacity (about 2 $^{5}/_{8}$ inches), distributing concrete spirally around inside perimeter of cone (See Figure 4)

E. Insert tamping rod in cone, and rod concrete twenty-five times, using the following procedures (See Figure 4)

   1. Use an up-and-down motion of the rod, rodding layer throughout its depth
   2. Distribute rod strokes evenly by starting at perimeter of cone and moving in a spiral toward center of cone

FIGURE 4



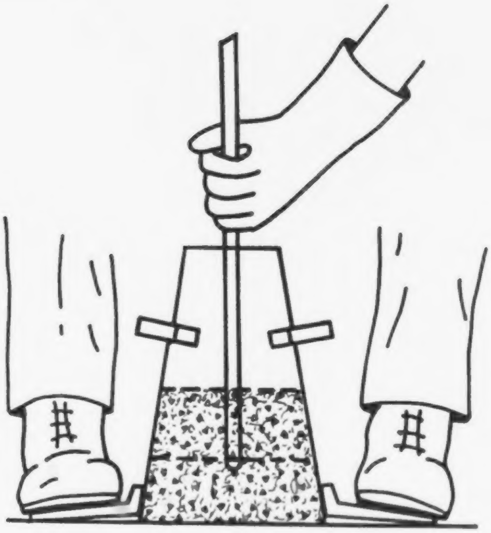
F. Fill next one-third of slump cone (to about 6 $^{1}/_{8}$ inches) with concrete, distributing concrete spirally around inside perimeter of cone (See Figure 5)

G. Rod concrete twenty-five times, using the following procedures (See Figure 5)

   1. Use an up-and-down motion, making rod just penetrate into underlying layer of concrete
   2. Distribute rod strokes evenly by starting at perimeter of cone and moving in a spiral toward center of cone

JOB SHEET #2

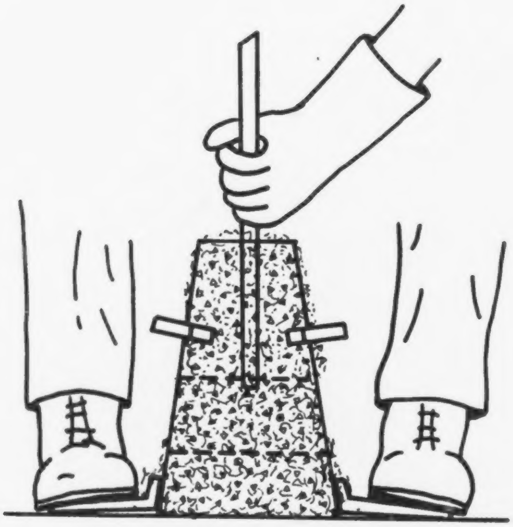
FIGURE 5



H. Fill slump cone to overflowing with concrete (See Figure 6)

I. Rod concrete twenty-five times, following the procedures in Step G and also adding additional concrete as necessary to keep concrete above top of cone (Figure 6)

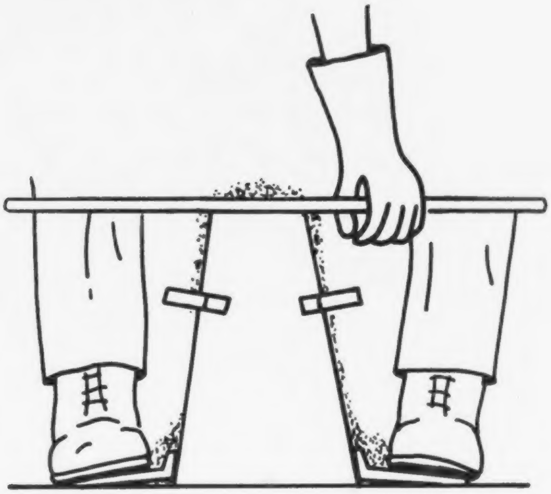
FIGURE 6



JOB SHEET #2

J. Using a screeding and rolling motion of tamping rod, strike off (level) excess concrete from top of slump cone (Figure 7)

FIGURE 7



K. Clean excess concrete away from base of slump cone

L. Raise slump cone from test sample with a steady, vertical (upward) lift

> **CAUTION**
>
> *Do not* move the cone laterally (sideways) or turn the cone in anyway that would disturb the test sample.

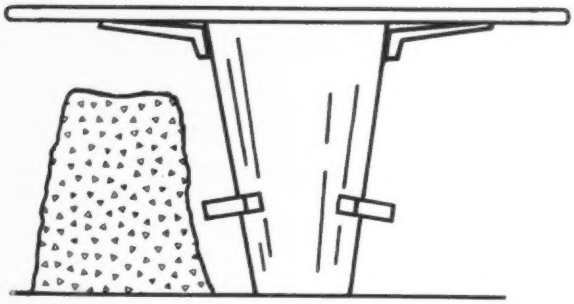
M. Turn slump cone upside down and gently place it next to test sample (See Figure 8)

> **CAUTION**
>
> *Do not* disturb the test sample.

N. Place tamping rod across slump cone's base so that rod extends over test sample (See Figure 8)

JOB SHEET #2

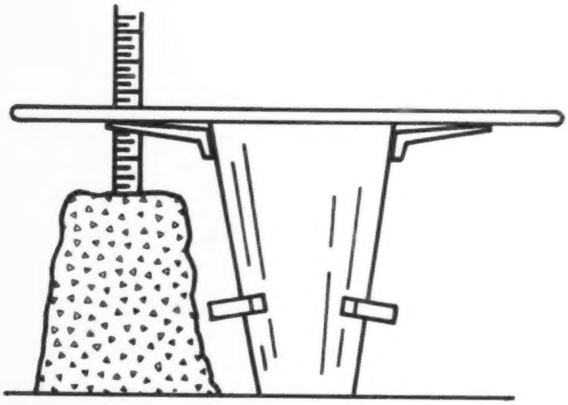
FIGURE 8



O. Using rule, measure (to nearest 1/4 inch) the distance from bottom of tamping rod to displaced center of test sample (Figure 9)

(NOTE: This measurement is called the *slump* of the concrete.)

FIGURE 9



P. Record the slump measurement in inches

Q. Clean test area and tools, and properly store tools and materials

SPECIFICATIONS AND TESTING
UNIT IV

JOB SHEET #3 — MAKE A CYLINDER-MOLD TEST SPECIMEN (ASTM C 31-84)

I. Tools and materials

- A. Clean, firm, level, nonabsorbant test surface

  EXAMPLES: Smooth plank, concrete slab

- B. Watertight cylinder mold

  (NOTE: The mold will be selected by your instructor.)

- C. Tamping rod

  (NOTE: The tamping rod for this procedure is a smooth, $^{5}/_{8}$-inch-by-24-inch bullet-nosed [hemispherical-tipped] steel rod.)

- D. Suitable storage area

  (NOTE: For initial curing, cylinder molds must be stored as near as practical to the testing area and in a place where the specimens will be protected from moisture loss and temperatures can be maintained in a range of from 60°F to 80°F.)

- E. Scoop or trowel
- F. Shovel
- G. Container of water
- H. Rubber or rawhide mallet
- I. Rubber gloves and protective clothing

  > **CAUTION**
  >
  > Always wear rubber gloves and protective clothing when working with fresh concrete.

- J. Moisture-proof material for covering mold specimen

  EXAMPLES: Nonabsorptive, nonreactive plate; tough, durable, impervious plastic

- K. Pencil
- L. Specimen tag

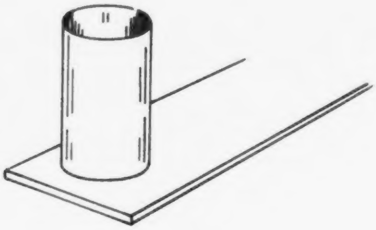
JOB SHEET #3

II. Procedure

A. Obtain representative concrete test sample (See Job Sheet #1)

B. Place cylinder mold on test surface (Figure 10)

FIGURE 10

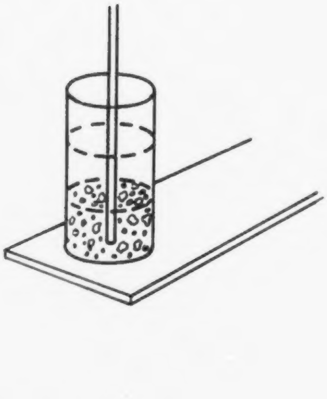


C. Fill cylinder mold with concrete to about one-third mold's capacity, distributing concrete spirally around inside perimeter of mold (See Figure 11)

D. Insert tamping rod in mold, and rod concrete twenty-five times, using the following procedures (See Figure 11)

1. Use an up-and-down motion of the rod, rodding layer throughout its depth
2. Distribute strokes evenly by starting at perimeter of mold and moving in a spiral toward center of mold

FIGURE 11



JOB SHEET #3

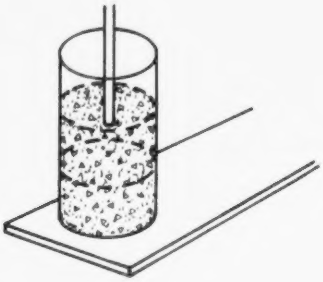
E. Tap sides of mold with mallet to close any voids left by tamping rod

F. Fill next one-third of mold with concrete, distributing concrete spirally around inside perimeter of mold (See Figure 12)

G. Rod concrete twenty-five times, using the following procedures (See Figure 12)

1. Use an up-and-down motion, making rod just penetrate into underlying layer of concrete
2. Distribute rod strokes evenly by starting at perimeter of mold and moving in a spiral toward center of mold

FIGURE 12

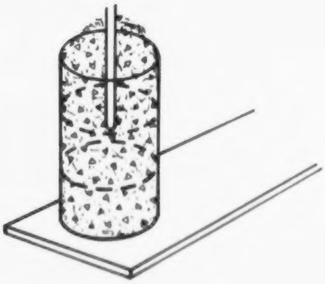


H. Tap sides of mold with mallet to close any voids left by tamping rod

I. Fill last-one third of mold with concrete, attempting to add an amount that will exactly fill the mold after rodding (See Figure 13)

J. Rod concrete twenty-five times, following procedures in Step G (Figure 13)

FIGURE 13

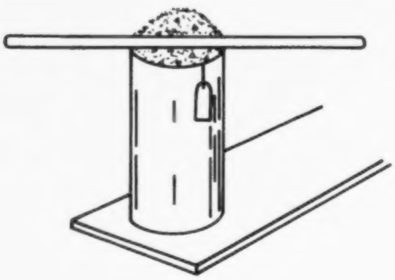


JOB SHEET #3

K. Tap sides of mold with mallet to close any voids left by tamping rod

L. Using a screeding and rolling motion of tamping rod, strike off (level) any excess concrete from top of mold to produce a flat even surface (Figure 14)

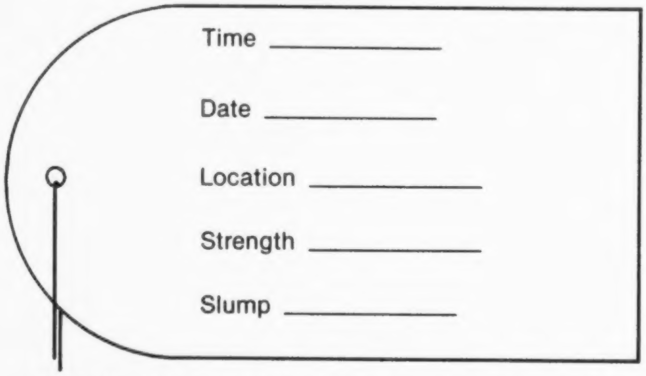
FIGURE 14



M. Tag speciman, noting time, date, and location of test and strength and slump of concrete (Figure 15)

(NOTE: Some companies use regular cattle tags and test forms to record test information, while some companies just mark test information on the sides of the molds.)

FIGURE 15



Time ______________

Date ______________

Location ______________

Strength ______________

Slump ______________

Opposite side has contractor's name and name of job.

JOB SHEET #3

N. Cover top of mold with moisture-proof material

O. Clean excess concrete from base of mold

P. Lift and support specimen from the bottom of the mold with a trowel or other device, and carefully transport specimen to storage area

> **CAUTION**
>
> Leave the mold undisturbed to cure in the storage area for at least twenty-four hours, and even after the initial curing period, handle the mold carefully to avoid damage to the specimen.

Q. Clean test area and tools, and properly store tools and materials

SPECIFICATIONS AND TESTING
UNIT IV

JOB SHEET #4 — MAKE A BEAM-MOLD TEST SPECIMEN (ASTM C 31-84)

I. Tools and materials

A. Clean, firm, level, nonabsorbent test surface

EXAMPLES: Smooth plank, concrete slab

B. Standard beam mold

(NOTE: A standard beam mold is 6 inches wide and 6 inches deep; the length must be at least 2 inches greater than three times the depth [20 inches].)

C. Tamping rod

(NOTE: The tamping rod for this procedure is a smooth, $^{5}/_{8}$-inch-by-24-inch, bullet-nosed [hemispherical-tipped] steel rod.)

D. Suitable storage area

(NOTE: For initial curing, beam molds must be stored as near as practical to the testing area and in a place where the specimens will be protected from moisture loss and temperatures can be maintained in a range of from 60°F to 80°F.)

E. Scoop or trowel

F. Shovel

G. Container of water

H. Rubber gloves and protective clothing

CAUTION

Wear rubber gloves and protective clothing when working with fresh concrete.

I. Rubber or rawhide mallet

J. Moisture-proof material for covering mold specimen

EXAMPLES: Nonabsorptive, nonreactive plate; tough, durable, impervious plastic

K. Pencil

L. Specimen tag

M. Wood or metal float

JOB SHEET #4

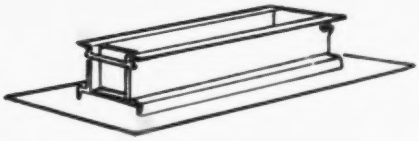
N. Form oil

II. Procedure

A. Obtain representative concrete test sample (See Job Sheet #1)

B. Place beam mold on test surface (Figure 16)

FIGURE 16



C. Coat mold with form oil

(NOTE: Form oil keeps the concrete from sticking to the mold.)

D. Fill beam mold with concrete to about one-third mold's capacity, distributing concrete around inside perimeter of mold

E. Rod concrete thirty times, using the following procedures

(NOTE: The number of roddings required for beam molds is one for each 2-inch-square top-surface area of the specimen.)

1. Use an up-and-down motion of the rod, rodding layer throughout its depth

2. Distribute strokes evenly over the cross section of the mold

F. Tap sides of mold with mallet to close any voids left by tamping rod

G. Spade sides and ends of mold with trowel

H. Fill next one-third of mold with concrete, distributing concrete around inside perimeter of mold

I. Rod concrete thirty times, using the following procedures

1. Use an up-and-down motion of the rod, making rod just penetrate into underlying layer of concrete

(NOTE: Allow the rod to penetrate about ½ inch into the underlying layer when the depth of the layer is less than 4 inches, and about 1 inch when the depth is 4 inches or more.)

2. Distribute strokes evenly over the cross section of the mold

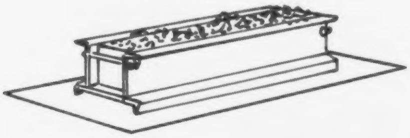
JOB SHEET #4

J. Tap sides of mold with mallet to close any voids left by tamping rod

K. Spade sides and ends of mold with trowel

L. Fill beam mold to overflowing with concrete (Figure 17)

FIGURE 17



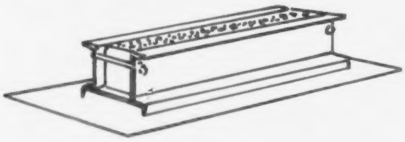
M. Rod concrete thirty times, following the procedures in Step I

N. Tap sides of mold with mallet to close any voids left by tamping rod

O. Spade sides and ends of mold with trowel

P. Level top of mold and finish specimen with float as required (Figure 18)

FIGURE 18



Q. Tag specimen, noting time, date, and location of test and strength and slump of concrete

(NOTE: Some companies use regular cattle tags and test forms to record test information, while some companies just mark test information on the sides of the molds.)

R. Cover top of specimen with moisture-proof material

S. Clean excess concrete from around beam mold

JOB SHEET #4

T. Lift and support specimen from the bottom of the mold, and carefully transport specimen to storage area

> **CAUTION**
>
> Leave the mold undisturbed to cure in the storage area for at least twenty-four hours, and even after the initial curing period, handle the mold carefully to avoid damage to the specimen.

U. Clean test area and tools, and properly store tools and materials

SPECIFICATIONS AND TESTING
UNIT IV

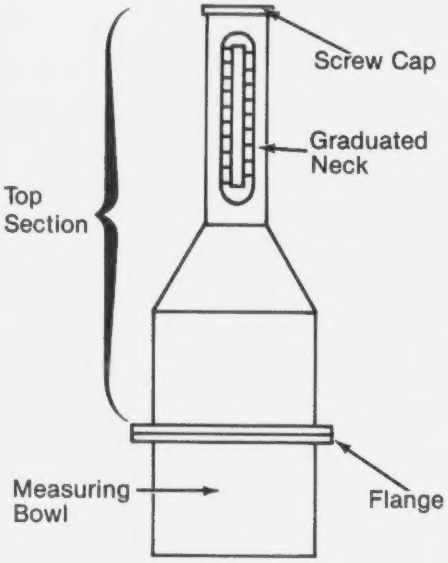
JOB SHEET #5 — PERFORM VOLUMETRIC-METHOD AIR-CONTENT TEST (ASTM C 173-78)

I. Tools and materials

A. Standard volumetric air meter (Figure 19)

(NOTE: The standard air meter is made of machined metal and consists of a bottom section [the measuring bowl] and a top section with a glass or transparent-plastic neck graduated from 0 at the top to at least 9 percent of the volume of the measuring bowl. The measuring bowl has a flange at or near the top surface. The upper end of the neck in the top section is threaded and equipped with a screw cap and gasket to make the cap watertight.)

FIGURE 19



B. Metal funnel

(NOTE: The spout of the funnel must be of a size that can be inserted into the neck of the top section of the air meter.)

C. Tamping rod

(NOTE: The tamping rod for this procedure is a smooth, 5/8-inch-by-12-inch, bullet-nosed [hemispherical-tipped] steel rod.)

D. Strike-off bar

(NOTE: The strike-off bar for this procedure is a flat, straight, 1/8-inch-by-3/4-inch-by-12-inch steel bar.)

E. Measuring cup

(NOTE: The volume of the measuring cup must be slightly larger than 1.0 percent of the volume of the air meter's bowl.)

F. Pouring vessel

(NOTE: The metal or glass pouring vessel should have a capacity of at least 1 quart.)

JOB SHEET #5

G. Small rubber-bulb syringe

H. Margin trowel

I. Small metal scoop

J. 70 percent isopropyl alcohol

(NOTE: Seventy percent isopropyl alcohol is commonly available as rubbing alcohol.)

K. Container of water

L. Rubber or rawhide mallet

M. Clean, firm, level test surface

EXAMPLE: Smooth plank

N. Rubber gloves and protective clothing

CAUTION

Always wear rubber gloves and protective clothing when working with fresh concrete.

O. Clean cloth

P. Pencil

Q. Chart for recording test results

II. Procedure

A. Obtain representative concrete test sample (See Job Sheet #1)

B. Dampen air-meter measuring bowl

C. Place bowl on test surface

D. Fill bowl with concrete to about one-third bowl's capacity, distributing concrete spirally around inside perimeter of bowl

E. Insert tamping rod in bowl, and rod concrete twenty-five times, using the following procedures

JOB SHEET #5

   1. Use an up-and-down motion of the rod, rodding layer throughout its depth but making sure that rod does not forcibly strike bottom of bowl
   2. Distribute strokes evenly by starting at perimeter of bowl and moving in a spiral toward center of bowl

F. Tap sides of bowl smartly ten to fifteen times with mallet

(NOTE: Tapping the sides of the bowl closes any voids left by the tamping rod and releases any large bubbles of air that may have been trapped in the concrete.)

G. Fill next one-third of bowl with concrete, distributing concrete spirally around inside perimeter of bowl

H. Rod concrete twenty-five times, using the following procedures

   1. Use an up-and-down-motion of the rod, making the rod just penetrate into underlying layer of concrete
   2. Distribute strokes evenly by starting at perimeter of bowl and moving in a spiral toward center of bowl

I. Tap sides of bowl smartly ten to fifteen times with mallet

J. Fill last one-third of bowl with concrete, but *do not* overflow bowl

K. Rod concrete twenty-five times, following procedures in Step H

L. Tap sides of bowl smartly ten to fifteen times with mallet

M. Strike off excess concrete until surface is flush with top of bowl

N. Wipe bowl flange clean

O. Clamp top section of air meter into position on bowl

P. Insert funnel into neck of top section

Q. Add water until you can see water in neck of meter

R. Remove funnel

S. Adjust water level with syringe until bottom of meniscus is level with zero mark on scale

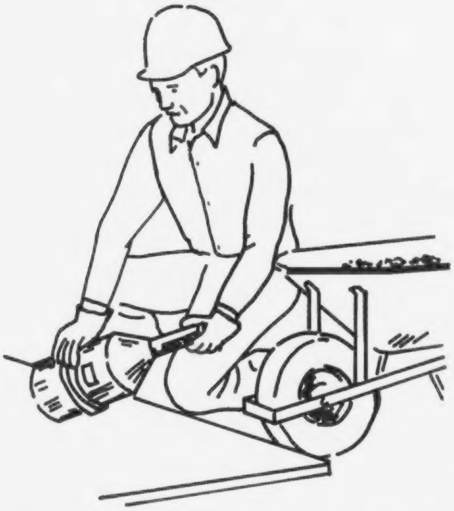
T. Attach and tighten screw cap

U. Invert and agitate air meter until concrete settles free from base

JOB SHEET #5

V. Elevate neck of air meter and roll and rock unit until air appears to have been removed from concrete (Figure 20)

FIGURE 20



W. Set air meter upright, jar lightly, and then allow it to stand until air rises to top

X. Repeat Step V until water level in column remains constant (until water level no longer drops)

Y. Remove screw cap when all air has been removed from concrete

Z. Add isopropyl alcohol in 1-cup increments until foam dissipates on surface of water

AA. Record number of cups of isopropyl alcohol required to dissipate foam

BB. Reading to bottom of miniscus, read level of liquid on scale to nearest 0.1 percent

CC. Record reading

DD. Clean test area and tools, and properly store tools and materials

SPECIFICATIONS AND TESTING
UNIT IV

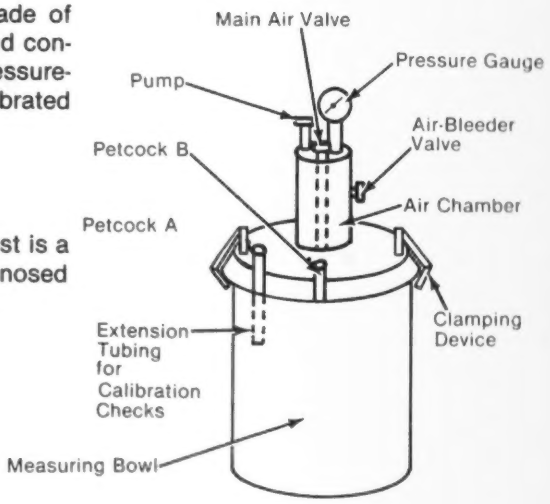
JOB SHEET #6 — USE TYPE-B AIR METER TO PERFORM PRESSURE-METHOD AIR-CONTENT TEST (ASTM C 231-82^{E1})

I. Tools and materials

A. Standard Type-B air meter (Figure 21)

(NOTE: A Type-B air meter is made of steel or some other hard metal and consists of a measuring bowl and a pressure-tight cover assembly with a calibrated pressure gauge.)

FIGURE 21


Main Air Valve
Pressure Gauge
Pump
Air-Bleeder Valve
Petcock B
Air Chamber
Petcock A
Clamping Device
Extension Tubing for Calibration Checks
Measuring Bowl

B. Tamping rod

(NOTE: The tamping rod for this test is a smooth, 5/8-inch-by-24-inch, bullet-nosed [hemispherical-tipped] steel rod.)

C. Scoop or trowel

D. Clean, firm, level test surface

EXAMPLE: Smooth plank

E. Rubber or rawhide mallet

F. Strike-off bar

(NOTE: The strike-off bar for this procedure is a flat, straight, 1/8-inch-by-3/4-inch-by-12-inch steel bar.)

G. Container of water

H. Clean cloth

I. Rubber syringe

J. Rubber gloves and protective clothing

CAUTION

Always wear rubber gloves and protective clothing when working with fresh concrete.

K. Pencil

L. Chart for recording test results

JOB SHEET #6

II. Procedure

A. Obtain representative concrete test sample (See Job Sheet #1)

B. Place measuring bowl on test surface

C. Dampen inside of measuring bowl

D. Fill measuring bowl with concrete to about one-third bowl's capacity, distributing concrete spirally around inside perimeter of bowl

E. Insert tamping rod in bowl, and rod concrete twenty-five times, using the following procedures

   1. Use an up-and-down motion of the rod, rodding layer throughout its depth but making sure that rod does not forcibly strike bottom of bowl

   2. Distribute strokes evenly by starting at perimeter of bowl and moving in a spiral toward center of bowl

F. Tap sides of bowl smartly ten to fifteen times with mallet to close any voids left by tamping rod

G. Fill next one-third of bowl with concrete, distributing concrete spirally around inside perimeter of bowl

H. Rod concrete twenty-five times, using the following procedures

   1. Use an up-and-down motion of the rod, making rod penetrate about 1 inch into underlying layer of concrete

   2. Distribute strokes evenly by starting at perimeter of bowl and moving in a spiral toward center of bowl

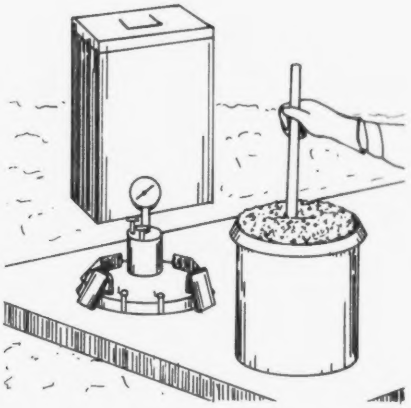
I. Tap sides of bowl smartly ten to fifteen times with mallet to close any voids left by tamping rod

J. Fill last one-third of bowl with concrete, but *do not* overflow bowl

K. Rod concrete twenty-five times, following procedures in Step H (Figure 22)

JOB SHEET #6

FIGURE 22



L. Tap sides of bowl smartly ten to fifteen times with mallet to close any voids left by tamping rod

M. Using a sawing motion of the strike-off bar, slide bar across rim of bowl to level concrete with top of bowl

N. Thoroughly clean rims of bowl and cover assembly

(NOTE: Cleaning the rims assures a pressure-tight seal when the cover assembly is clamped in place.)

O. Moisten inside of cover assembly and its rubber seal

P. Clamp on cover assembly

Q. Close air valve between air chamber and bowl

R. Open Petcocks A and B on the holes through the cover

S. Holding syringe in one hand, inject water through Petcock A until water comes out Petcock B, while using other hand to gently jar and tap meter until no air bubbles come from Petcock B

T. Close air-bleeder valve on air chamber

U. Pump air into air chamber until gauge hand reaches initial pressure line

V. Allow compressed air to cool for a few seconds

W. Stabilize gauge hand to initial pressure by pumping or bleeding off air as necessary

JOB SHEET #6

X. Close Petcocks A and B on holes through cover

Y. Open air valve between air chamber and measuring bowl

Z. Tap sides of measuring bowl sharply to relieve local restraints

AA. Lightly tap pressure gauge to stabilize gauge hand

BB. Read percentage of air on pressure-gauge dial

CC. Record reading

DD. Close main air valve, and *then* open both petcocks to release pressure

> **CAUTION**
>
> Failure to close the main air valve before releasing the pressure from either the container or the air chamber will cause water to be drawn into the air chamber, resulting in an incorrect reading on the next measurement.

EE. Remove cover

FF. Clean test area and tools, and properly store tools and materials

SPECIFICATIONS AND TESTING
UNIT IV

JOB SHEET #7 — PERFORM TEMPERATURE TEST

I. Tools and materials

   A. ASTM-approved thermometer (Figures 23 and 24)

      (NOTE: An ASTM-approved thermometer is accurate to +1°F, readable to 0.5°F, and has a temperature range from 0.0°F to 120°F.)

   B. Container of water

   C. Rubber gloves and protective clothing

CAUTION

Always wear rubber gloves and protective clothing when working with fresh concrete.

   D. Pencil

   E. Chart for recording test results

FIGURE 23

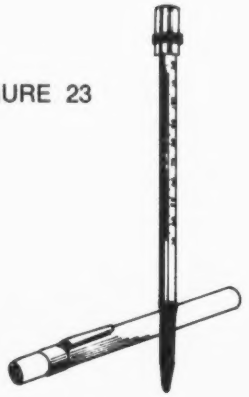
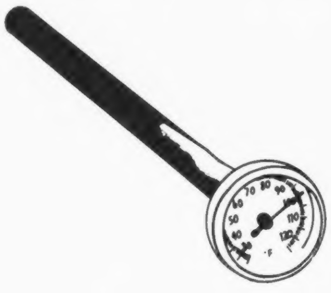


FIGURE 24



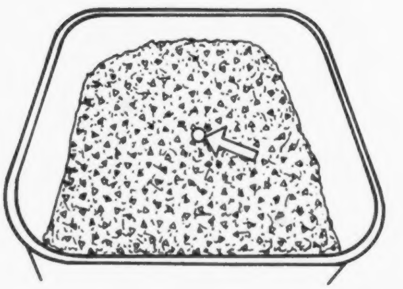
II. Procedure

   A. Obtain representative concrete test sample (See Job Sheet #1)

      (NOTE: The sample must be large enough to provide at least a 3-inch cover in all directions around the thermometer's sensor.)

   B. Insert thermometer's sensor into test concrete near center of sample (Figure 25)

FIGURE 25



JOB SHEET #7

C. Gently press concrete around thermometer

D. Leave thermometer undisturbed for at least *two minutes*, or until temperature reading becomes stable

E. Read temperature to nearest degree F

F. Record reading

(NOTE: It is usually advisable to take more than one temperature reading. Additional sample readings can be taken, or readings can also be taken from placed concrete if they are taken immediately after the concrete has been placed.)

G. Remove thermometer from test concrete

H. Clean test area and tools, and properly store tools and materials

SPECIFICATIONS AND TESTING
UNIT IV

JOB SHEET #8 — PERFORM UNIT-WEIGHT TEST
(ASTM C 29-78 ^{E2})

I. Tools and materials

  A. Balance or scale

  (NOTE: The balance or scale must be accurate within 0.1 percent of the test load at any point within the range of use.)

  B. Tamping rod

  C. 0.5 cubic-foot, cylindrical metal measure with handles (Figure 26)

  D. Strike-off plate

  (NOTE: The strike-off plate for this procedure may be a metal, glass, or acrylic strightedge.)

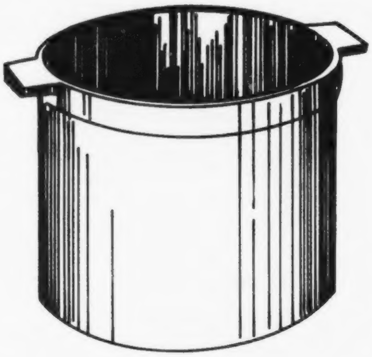
  E. Scoop or trowel

  F. Level, rigid, horizontal test surface

  EXAMPLE: Smooth plank

  G. Rubber gloves and protective clothing

FIGURE 26



> **CAUTION**
>
> Always wear rubber gloves and protective clothing when working with fresh concrete.

  H. Pencil

  I. Chart for recording test results

II. Procedure

  A. Obtain representative concrete test sample (See Job Sheet #1)

  B. Place balance on test surface

  C. Carefully place empty measure on balance

JOB SHEET #8

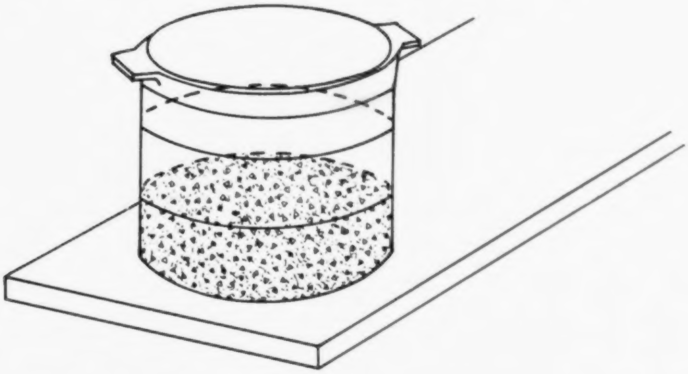
D. Read weight of empty measure

E. Record weight of empty measure

F. Return measure to test surface

G. Fill measure with concrete to about one-third measure's capacity, distributing concrete spirally around inside perimeter of measure (Figure 27)

FIGURE 27

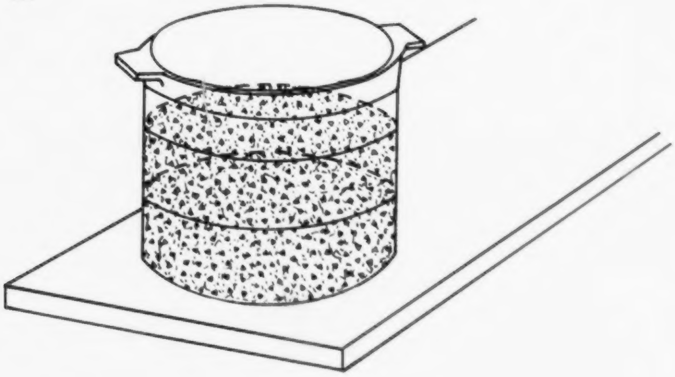


H. Insert tamping rod in measure, and rod concrete twenty-five times, using the following procedures

1. Use an up-and-down motion of the rod, rodding layer throughout its depth but making sure that rod does not forcibly strike bottom of measure
2. Distribute strokes evenly by starting at perimeter of measure and moving in a spiral toward center of measure

I. Fill next one-third of measure with concrete, distributing concrete spirally around inside perimeter of measure (Figure 28)

FIGURE 28



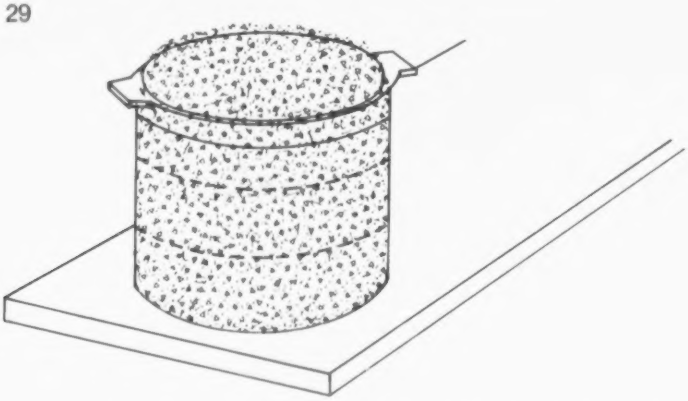
JOB SHEET #8

J. Rod concrete twenty-five times, using the following procedures

1. Use an up-and-down motion of the rod, making rod just penetrate into underlying layer of concrete
2. Distribute strokes evenly by starting at perimeter of measure and moving in a spiral toward center of measure

K. Fill measure to overflowing with concrete (Figure 29)

FIGURE 29



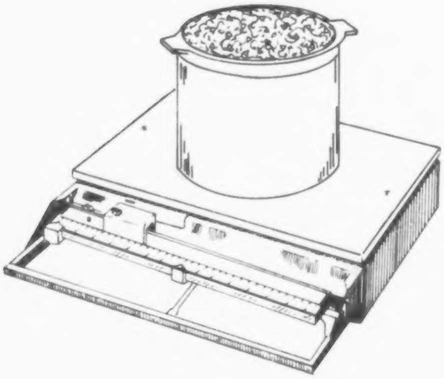
L. Rod concrete twenty-five times, following procedures in Step J

M. Strike off concrete level with top of measure

N. Clean excess test concrete away from measure

O. Carefully place filled measure on balance (Figure 30)

FIGURE 30



JOB SHEET #8

P. Read combined weight of measure and its contents

Q. Record combined weight to nearest 0.1 percent

R. Calculate unit weight of concrete

   1. Subtract weight of empty measure from combined weight of measure and its contents to obtain weight of concrete, using the formula

      Combined Weight of Measure and Its Contents — Weight of Empty Measure = Weight of Concrete

   2. Multiply weight of concrete times 2 to obtain unit weight (cubic-foot weight) of concrete, using the formula

      Weight of Concrete × 2 = Unit Weight of Concrete

S. Record unit weight of concrete

T. Clean test area and tools, and properly store tools and materials

SPECIFICATIONS AND TESTING
UNIT IV

TEST

NAME ________________________________ SCORE ______________

1. Select correct definitions of terms associated with specifications and testing. Write an "X" in the blank before the best definition.

a. **Tolerance**

______1. Acceptable variance from standard

______2. Measure of the consistency of freshly mixed concrete

______3. Acceptable arrangement of lines to indicate actual size of an object

b. **Slump**

______1. Relative ability of freshly mixed concrete to flow

______2. Tendency of materials in a mix to separate

______3. Measure of the consistency of freshly mixed concrete

c. **Specifications**

______1. Detailed agreement between owner and contractor about equipment to be used during construction

______2. Set of orders issued and signed by owner authorizing contractor to make any changes pertaining to materials and equipment

______3. Detailed set of written instructions that supplements the drawings in a set of plans, describes equipment and materials used in the structure, and becomes part of the contract

d. **Consistency**

______1. Measure of the consistency of freshly mixed concrete

______2. Relative ability of freshly mixed concrete to flow

______3. Selection of ingredients to make the most economical use of available materials

e. **Factor**

______1. Item that pertains to accomplishing the finished product

______2. Listing of parts, amounts, materials or products, and details

______3. Item that contributes to the production of a part of an object

TEST

f. **Dimensions**

______1. Acceptable arrangement of lines

______2. Conventional lines and figures used to indicate actual sizes and distances of objects and spaces represented on plans

______3. Directions for workers to use on the job

g. **American Concrete Institute (ACI)**

______1. Nonprofit membership organization dedicated to public service and to representing users' interests in the field of concrete

______2. Profit-based organization dedicated to selling concrete products to wholesale distributors

______3. Government organization dedicated to establishing proper test procedures for concrete

h. **Segregate**

______1. To separate

______2. To aggregate

______3. To flow

i. **Grout**

______1. To segregate

______2. Mixture of cementitious materials and water proportioned to produce a pourable consistency without segregation of components

______3. Measure of the consistency of freshly mixed concrete

2. Discuss reasons concrete masons read specifications.

____

____

____

____

____

____

____

TEST

3. Select from the following list concrete-related factors included in specifications. Write an "X" in the blank before each correct answer.

______a. Dimensions of materials to be used

______b. Construction methods required

______c. Slump required for concrete

______d. Tolerances allowed

______e. Type and quality of materials to be used

______f. Concrete finishes required

______g. Strength required of fresh concrete

______h. Maximum sand/cement ratio allowed in concrete

______i. Types and methods of concrete curing required

______j. Percentage of air required in concrete

______k. Dimensions of concrete components to be constructed

4. Match to their correct descriptions types of fresh-concrete and hardened-concrete sampling and testing procedures commonly performed by concrete masons. Write the correct numbers in the blanks.

Fresh-concrete sampling and testing procedures

______a. Procedure completed at job site to obtain a measure of air content in concrete

______b. Procedure to obtain representative composite samples of fresh concrete from stationary and paving mixers, truck mixers, agitators, and dump trucks

______c. Procedure completed at job site to obtain concrete sample to be cured and used later in laboratory compression tests

______d. Procedure completed at job site to obtain a concrete sample to be used later in laboratory flexural-strength tests

______e. Procedure completed at job site to check internal temperature of fresh concrete

______f. Procedure completed at job site to measure cubic-foot weight of fresh concrete

______g. Procedure completed at job site to obtain a molded sample used as a rough measure of the consistency of fresh concrete

1. Unit-weight test (ASTM C 29-78^{E2})
2. Temperature test
3. Air-content test
4. Beam molding (ASTM C 31-84)
5. Cylinder molding (ASTM C 31-84)
6. Slump test (ASTM C 143-78)
7. Sampling (ASTM C 172-82)

TEST

Hardened-concrete sampling and testing procedures

_____a. Procedure completed at job site to obtain a hardened-concrete sample to be used later in laboratory compression tests

_____b. Procedure performed at job site on hardened, in-place concrete to determine when forms can be removed or when loads can be applied to structure

1. Core sampling
2. Impact test (hammer test, probe test)

(NOTE: Test items 5 and 6 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

5. Read and interpret specifications pertaining to concrete.

6. Demonstrate the ability to

   a. Obtain representative fresh-concrete test samples (ASTM C 172-82).

   b. Perform a slump test (ASTM C 143-78).

   c. Make a cylinder-mold test specimen (ASTM C 31-84).

   d. Make a beam-mold test specimen (ASTM C 31-84).

   e. Perform volumetric-method air-content test (ASTM C 173-78).

   f. Use Type-B air meter to perform pressure-method air-content test (ASTM C 231-82^{E1}).

   g. Perform temperature test.

   h. Perform unit-weight test (ASTM C 29-78^{E2}).

SPECIFICATIONS AND TESTING
UNIT IV

ANSWERS TO TEST

1. a. 1
   b. 3
   c. 3
   d. 2
   e. 1
   f. 2
   g. 1
   h. 1
   i. 2

2. Discussion should include the following.

   a. To obtain supplemental information drawings alone cannot provide
   b. To obtain complete descriptions concerning methods of construction
   c. To obtain complete descriptions of standards of construction
   d. To obtain a complete listing of the quantity of materials to be used during construction

3. a, b, c, d, e, f, i, j, k

4. **Fresh-concrete sampling and testing procedures**

   a. 3
   b. 7
   c. 5
   d. 4
   e. 2
   f. 1
   g. 6

   Hardened-concrete sampling and testing procedures

   a. 1
   b. 2

5. Evaluated to the satisfaction of the instructor.

6. Performance skills evaluated to the satisfaction of the instructor.

FORMING TOOLS
UNIT I

UNIT OBJECTIVE

After completing this unit, the student should be able to match the correct forming tool to the job and demonstrate proper care and safe use of forming tools. The student will show this ability by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with forming tools.
2. State rules for care and safe use of hand tools.
3. State rules for safe use of portable circular saws.
4. State rules for proper care of leveling instruments.
5. Match types of hammers to their correct uses.
6. Match types of saws to their correct uses.
7. Match types of squares to their correct uses.
8. Match types of measuring tools to their correct uses.
9. Match types of leveling instruments to their correct uses.
10. Match miscellaneous forming tools and equipment to their correct uses.
11. Demonstrate the ability to
    a. Set and drive nails with a nail hammer.
    b. Use a crosscut hand-saw.
    c. Use a hacksaw.
    d. Use a portable circular saw to perform straight and angle cut-off operations.
    e. Use framing square and rule to lay out a square corner.
    f. Use a level.

FORMING TOOLS
UNIT I

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Information sheet

   D. Job sheets

      1. Job Sheet #1 — Set and Drive Nails with a Nail Hammer

      2. Job Sheet #2 — Use a Crosscut Hand-Saw

      3. Job Sheet #3 — Use a Hacksaw

      4. Job Sheet #4 — Use a Portable Circular Saw to Perform Straight and Angle Cut-Off Operations

      5. Job Sheet #5 — Use Framing Square and Rule to Lay Out a Square Corner

      6. Job Sheet #6 — Use a Level

   E. Test

   F. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials to supplement unit.

      1. Samples of tools, equipment, and materials listed in the information sheet

      2. Equipment and materials needed for procedures outlined in the job sheets

      3. Tool catalogs from various manufacturers

         EXAMPLES: *Stanley Tool Guide, Paxton Patterson Tool Catalog, Goldblatt Tool Catalog*

SUGGESTED ACTIVITIES

4. Audiovisual presentations

    a. Film — *Safety in the Shop: Hand Tools*. Black and white, 13.5 minutes, Coronet Films, 1970. Available from Coronet Films, 65 East Southwater Street, Chicago, Illinois 70701.

    b. Slide set — *Tool Identification Slides*. Available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074.

5. Newspaper clippings or case studies that relate to forming-tool use

6. Competency profiles

    (NOTE: Competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

C. Introduce unit.

SUGGESTIONS:

- Display samples of tools and equipment needed for form setting. Discuss the different tools and their uses.
- Display tool catalogs for students to review.
- Tour a construction site where concrete masons are setting forms. Relate tools illustrated in this unit to the ones being used on the job.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives.

SUGGESTIONS:

- Relate objectives to your introduction of the unit.
- Relate job sheets to specific objectives.
- Show the slide set *Tool Identification Slides*.

F. Provide students with information and job sheets.

G. Discuss information and job sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with forming tools, showing samples of tools and materials when appropriate to illustrate terms.

SUGGESTED ACTIVITIES

2. Use Information Sheet, Sections II through IV, to discuss rules for care and safe use of hand tools, portable circular saws, and leveling instruments.

SUGGESTIONS:

- Explain the importance of buying quality tools. Explain how good care will preserve the tools so that they will last for many years.
- Discuss how safe and proper use of tools will save tools and prevent accidents.
- Show the film *Safety in the Shop: Hand Tools*.
- Have students explain details of accidents they know of when someone used tools improperly.
- Discuss newspaper clippings or case studies that relate to improper use of tools.
- Demonstrate to students how to clean and store tools properly.
- Demonstrate how the quality and quantity of work increases when using sharp tools in good condition compared to using dull tools in poor condition.
- Explain your policy for replacement and repair of damaged tools.
- Outline your tool-management system for shop and job site.
- Stress that leveling instruments are expensive precision instruments that must be handled very carefully.
- Explain how dropping and bumping builder's levels or laser-beam levels can cause them to be inaccurate.
- Explain that dropping and bumping a small leveling instrument such as the spirit, torpedo, or line level can also affect its accuracy. Further explain that the water level is probably the least likely to be damaged when being handled.

3. Use Information Sheet, Section V, to discuss types of hammers and their correct uses.

SUGGESTIONS:

- Display samples of the actual hammers used to set forms.
- Discuss the different uses of these hammers, and explain why they are used for those specific jobs.

SUGGESTED ACTIVITIES

- Demonstrate procedures in Job Sheet #1, "Set and Drive Nails with a Nail Hammer," and allow students to practice these procedures.
- Have students complete Job Sheet #1.

4. Use Information Sheet, Section VI, to discuss types of saws and their correct uses.

   SUGGESTIONS:

   - Display samples of the actual saws discussed in this section of the information sheet.
   - Discuss proper use of each saw, and allow the students to handle and examine each saw.
   - Demonstrate making a straight cut with each saw.
   - Caution students against mishandling saws, and discuss the damage that can be done to the saws and to the workpiece if the saw is mishandled. Have students consider the expense of repairing or replacing tools.
   - Explain to the students how saw blades are sharpened.
   - Demonstrate correct procedures for replacing a blade in the hacksaw frame and the proper way the blade goes into the frame so that the teeth on the blade point away from the handle.
   - Demonstrate and discuss the procedures outlined in Job Sheets #2 through #4.
   - Have students practice these procedures and then complete Job Sheets #2 through #4.

5. Use Information Sheet, Section VII, to discuss types of squares and their correct uses.

   SUGGESTIONS:

   - Display samples of the actual squares discussed in this section of the information sheet.
   - Allow students to handle and examine the squares.
   - Discuss proper use of each square.
   - Caution students about careful handling of the squares: Explain how squares are accurate instruments and if damaged they are no good to the craftsman.

SUGGESTED ACTIVITIES

- Demonstrate and discuss procedures outlined in Job Sheet #5, "Use Framing Square and Rule to Lay Out a Square Corner."

- Have students practice procedures and then complete Job Sheet #5.

6. Use Information Sheet, Section VIII, to discuss types of measuring tools and their correct uses.

   SUGGESTIONS:

   - Display samples of the actual measuring tools discussed in this section of the information sheet. You may want to show students different rules and tapes that you have available.

     EXAMPLES: Folding rules—6 foot and 8 foot; steel tapes in various lengths—6 foot, 8 foot, 12 foot, 20 foot, 25 foot, 50 foot, and 100 foot

   - Discuss proper use of rules and tapes.

   - Caution students about keeping the joints on their folding rules oiled and clean so that the rules will operate efficiently and are less liable to break.

   - Caution students about kinking their steel tapes: Kinking steel tapes causes weak places in the tapes that will break.

   - Stress the importance of proper care of tapes. Explain that improper care can cause inaccurate measurements. Suggest that students clean tapes and apply a thin coat of oil before winding tapes back into their cases.

7. Use Information Sheet, Section IX, to discuss types of leveling instruments and their correct uses.

   SUGGESTIONS:

   - Display samples of the leveling instruments illustrated in this section of the information sheet.

   - Demonstrate procedures for setting up a builder's level, pointing out correct handling of the level and the storage case. Refer to Section D, Unit V, "Builder's Level," for the proper procedures for setting up this instrument.

   - Demonstrate and discuss the proper use of each of the levels referred to in this section of the information sheet.

SUGGESTED ACTIVITIES

- Demonstrate and discuss the procedures in Job Sheet #6, "Use a Level."

- Have students practice the procedures and then complete Job Sheet #6.

8. Use Information Sheet, Section X, to discuss uses of miscellaneous forming tools and equipment.

   SUGGESTIONS:

   - Display samples of the various forming tools discussed in this section of the information sheet. Allow students to handle and examine each tool.

   - Discuss and demonstrate proper use of each of these tools.

   - Have students practice using these tools.

H. Set up contests to determine which students can use forming tools safely, quickly, and accurately.

I. Give test.

J. Critique test and discuss in class.

K. Reteach and retest as necessary.

L. Complete appropriate section of competency profiles.

III. Unit references

A. Hendrix, Laborn J. "Bud". *Cement Masonry Curriculum*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1975.

B. Hendrix, Laborn J. "Bud". *Fundamentals of Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1985.

C. *Stanley Tool Guide*. New Britain, Connecticut: Stanley Tools, Division of the Stanley Works, 1968.

FORMING TOOLS
UNIT I

INFORMATION SHEET

I. Terms and definitions associated with forming tools

A. Rip — To saw wood with the grain

B. Crosscut — To saw wood across the grain

C. Square — To form a right angle; 90 degrees to a straight line

D. Grade — Given elevation to which forms are set

E. Elevation — Given grade

F. Plumb bob — Tool or device attached to a string; used to set and check the vertical or perpendicular of a surface

G. Leveling rod — Pole with markings graduated upward from zero; used with leveling instrument to determine elevations

H. Stake — Pointed piece of wood or metal driven into ground and used to hold forms in place

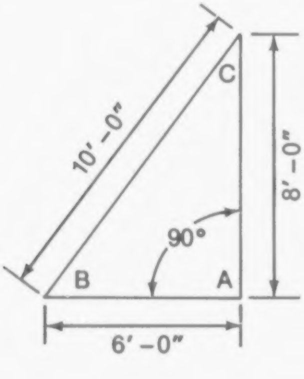
I. Soapstone — Soft stone used for marking

(NOTE: Soapstones are made of talc, chlorite, and often some magnetite, and they have a soapy feel.)

J. 3-4-5 method — Method of squaring a line by forming a right triangle using largest multiple of 3-4-5 possible for length of lines being squared, and ensuring that longest side of triangle is exact appropriate multiple of 5

EXAMPLE: Using 3-4-5 method to square building lines 6′ –0″ × 8′ –0″, Line BC will measure exactly 10 feet. See Figure 1.

FIGURE 1



INFORMATION SHEET

II. Rules for care and safe use of hand tools

A. Use the correct tool for the job

B. Keep tools clean

C. Keep tools dry

D. Keep tools sharp

E. Inspect tools frequently to make sure they are in good condition

F. Repair broken or damaged tools promptly

G. Dispose of broken tools that cannot be repaired

H. *Do not* use broken tools

I. *Do not* throw tools

J. Protect cutting edge of tools when carrying and storing

K. Store tools properly when not in use

(NOTE: *Do not* carry tools in your pockets; *do not* place tools where they can roll off; protect cutting edges; lightly oil tools before storing; store tools in a dry place.)

L. Wear eye protection when appropriate

M. Stay alert when using hand tools

EXAMPLES: Keep fingers away from cutting edges; work away from your body when using cutting tools; be sure everyone is clear before you swing a sledgehammer.

III. Rules for safe use of portable circular saws

A. Keep electric cord clear of blade to avoid cutting cord

B. Be sure that automatic guard is free and retractable

CAUTION

Never lock automatic guard in the retracted position.

C. Check stock for nails and any other metal before cutting

D. Use a good, solid support for stock while cutting

INFORMATION SHEET

E. Allow saw to gain maximum speed before starting cut

F. Set blade only deep enough to cut through stock

G. Lay saw on its side after finishing the cut

IV. Rules for proper care of leveling instruments

(NOTE: Leveling instruments are sensitive instruments that require extremely careful treatment.)

A. Protect instrument from shock and vibration

B. *Never* force screws or other moving parts of the instrument

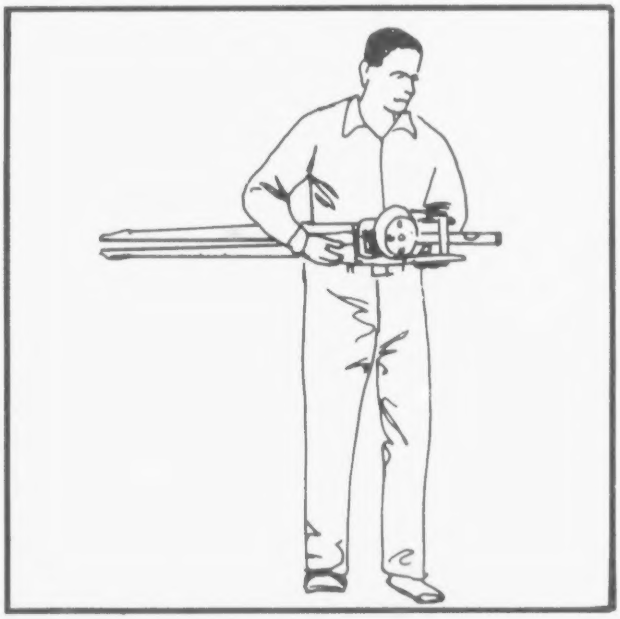
C. Loosen leveling screws before returning instrument to carrying case

D. Carry tripod under your arm with the instrument in front of you (Figure 2)

(NOTE: *Never* carry tripod over your shoulder when instrument is attached.)

EXAMPLE:

FIGURE 2



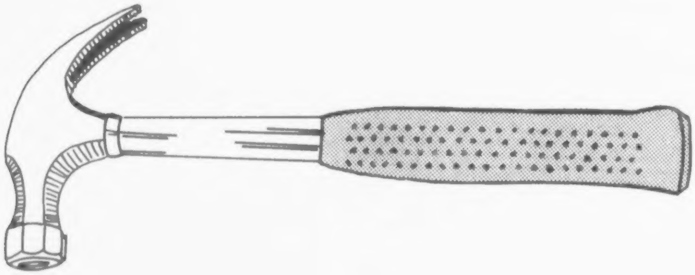
INFORMATION SHEET

V. Uses of types of hammers (Figures 3-5)

A. Curved-claw hammer — Used to drive and pull nails

EXAMPLE:

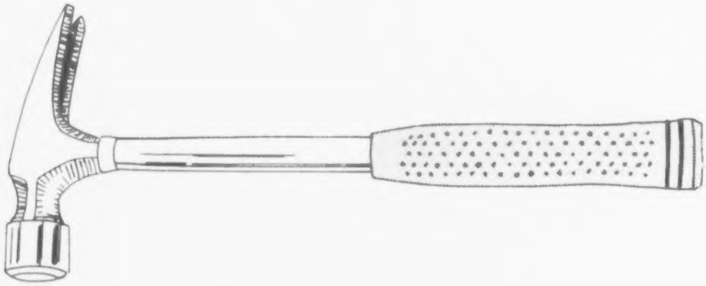
FIGURE 3



B. Straight-claw hammer — Used to drive nails, pull nails, dismantle, and wreck

EXAMPLE:

FIGURE 4



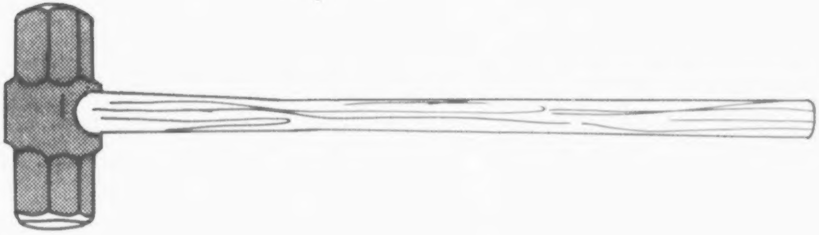
INFORMATION SHEET

C. Sledgehammer — Used to drive stakes and break concrete

(NOTE: Sledgehammers used for forming operations weigh from 6 pounds to 12 pounds depending on the job they are to be used for.)

EXAMPLE:

FIGURE 5



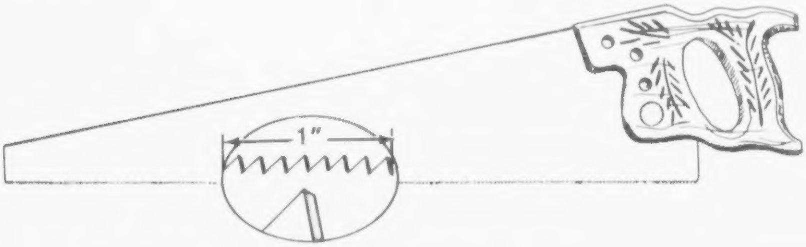
VI. Uses of types of saws (Figures 6-9)

A. Crosscut hand-saw — Used to cut across the grain of wood

(NOTE: Crosscut saws come in lengths of 20 inches to 26 inches with four to twelve points per inch; teeth are filed at an angle across the face. See Figure 6.)

EXAMPLE:

FIGURE 6



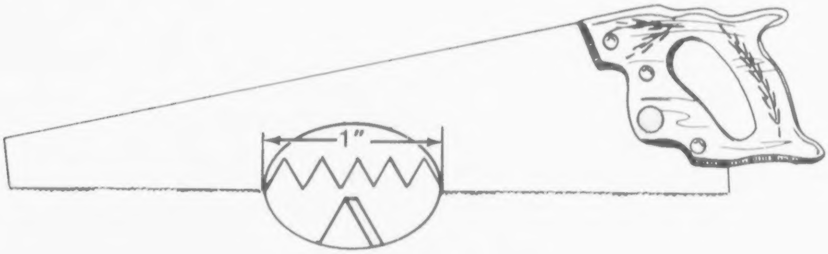
INFORMATION SHEET

B. Rip hand-saw — Used to cut with the grain of wood

(NOTE: Ripsaws come in lengths of 20 inches to 28 inches with five to seven points per inch; teeth are filed square across the face. See Figure 7.)

EXAMPLE:

FIGURE 7

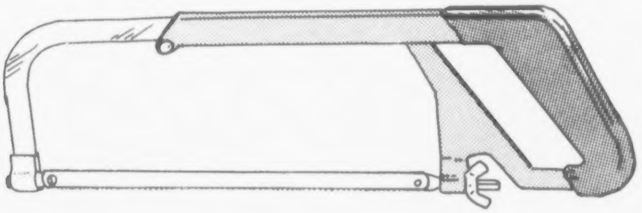


C. Hacksaw — Used to cut metal

(NOTE: Hacksaws have U-shaped frames and replaceable blades that come in lengths of 8 inches to 12 inches.)

EXAMPLE:

FIGURE 8

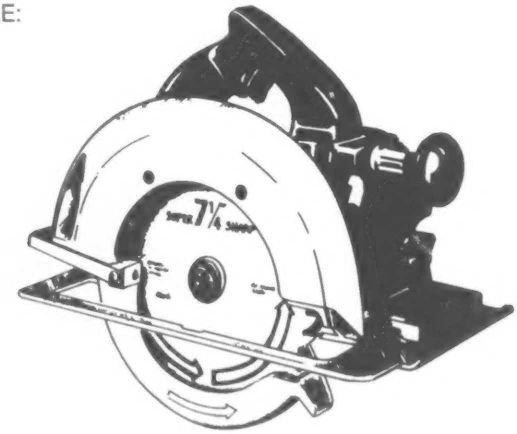


INFORMATION SHEET

D. Portable power circular saw — Used to rip and crosscut form material (Figure 9)

EXAMPLE:

FIGURE 9



VII. Uses of types of squares (Figures 10 and 11)

A. Framing square — Used to square corners, check squareness, and lay out 90-degree angles

EXAMPLE:

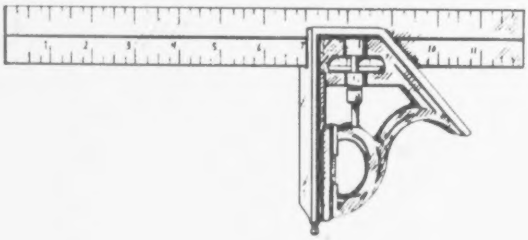
FIGURE 10

INFORMATION SHEET

B. Combination square — Used to check squareness and to lay out 45-degree angles

EXAMPLE:

FIGURE 11



VIII. Uses of types of measuring tools (Figures 12-14)

A. Flexible steel tape — Used to measure irregular as well as regular shapes and to make accurate inside and outside measurements

(NOTE: Flexible steel tapes slide into a metal case. Most short tapes come in 6-foot to 25-foot lengths; long tapes come in 50-foot to 100-foot lengths. Both types of flexible steel tapes have a hook or loop on the end adjusted to true zero.)

EXAMPLES:

FIGURE 12

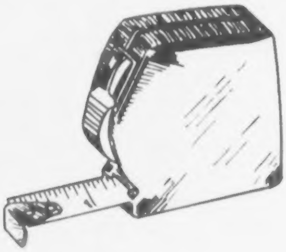
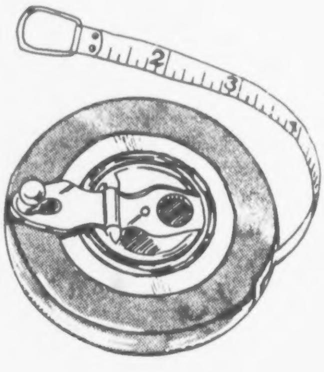


FIGURE 13

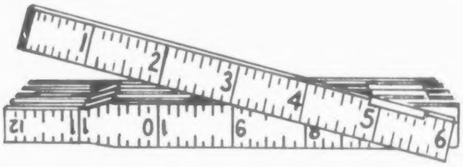


INFORMATION SHEET

B. Folding rule (zigzag rule) — Used to make accurate inside and outside measurements for laying out forms, laying out joints, and checking for square

EXAMPLE:

FIGURE 14

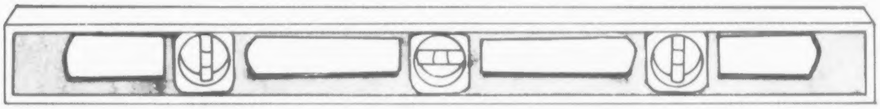


IX. Uses of types of leveling instruments (Figures 15-20)

A. Spirit level — Used to level forms and to transfer and check grades

EXAMPLE:

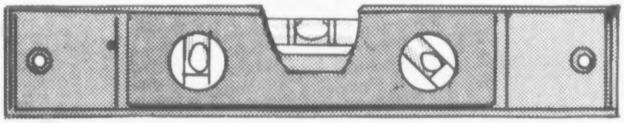
FIGURE 15



B. Torpedo level — Used to check grades on short forms such as step treads

EXAMPLE:

FIGURE 16

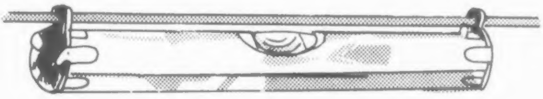


INFORMATION SHEET

C. Line level — Used to check grades of a dry line

EXAMPLE:

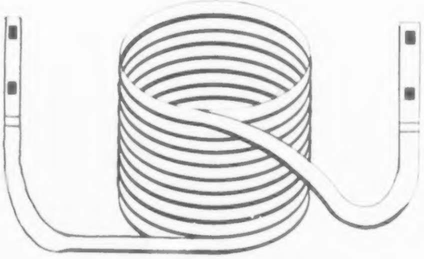
FIGURE 17



D. Water level — Used to set and check elevations

EXAMPLE:

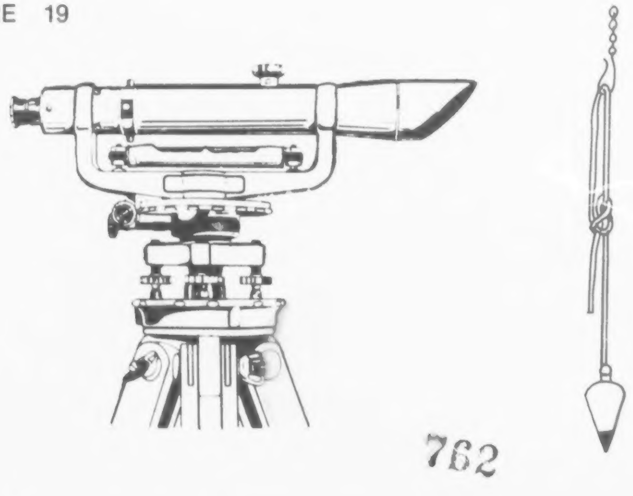
FIGURE 18



E. Builder's level (with plumb bob) — Used to check elevations and to transfer and check grades (Figure 19)

EXAMPLE:

FIGURE 19

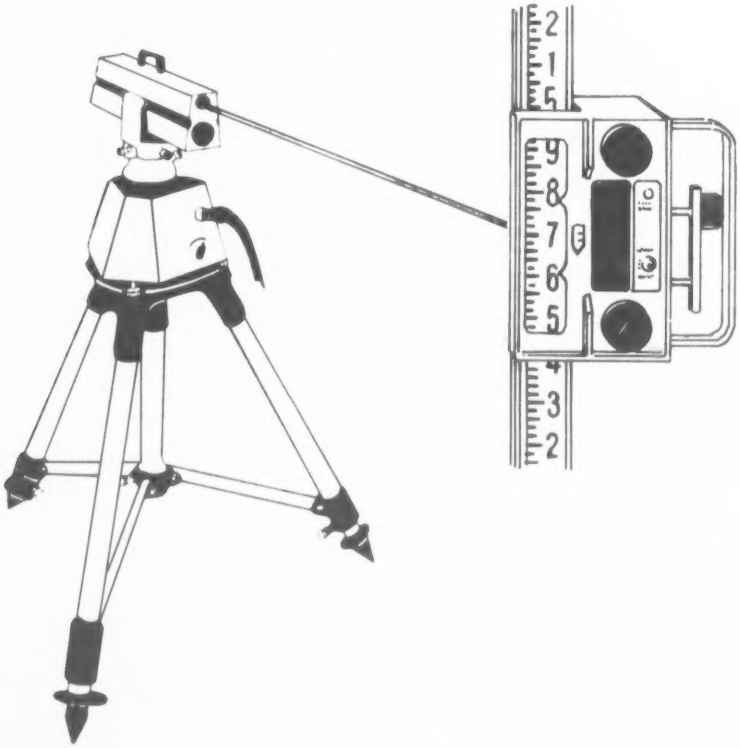


INFORMATION SHEET

F. Laser-beam level (with leveling rod) — Used to establish and check elevations and to establish, check, and transfer grades (Figure 20)

EXAMPLE:

FIGURE 20

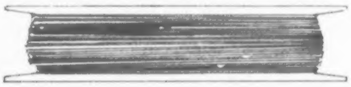


X. Uses of miscellaneous forming tools and equipment (Figures 21-28)

A. Line (string line; dry line) — Used as a guide to set stakes and forms straight and accurately

EXAMPLE:

FIGURE 21

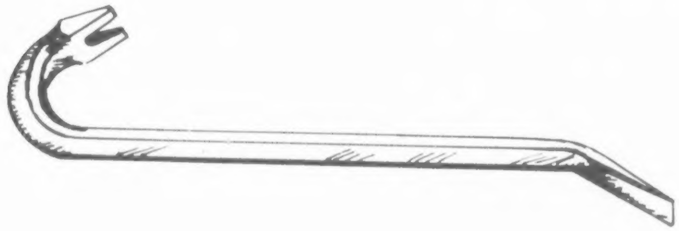


INFORMATION SHEET

B. Ripping bar (wrecking bar) — Used to pull nails, to pry, and to remove forms

EXAMPLE:

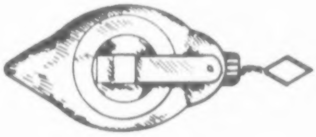
FIGURE 22



C. Chalk box and line — Used to lay out work on concrete, to lay out cut lines on lumber, and to mark joints in concrete

EXAMPLE:

FIGURE 23



D. Magnetic nail driver — Used to drive short masonry nails through expansion material and into masonry wall when setting expansion material

EXAMPLE:

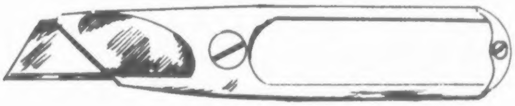
FIGURE 24

INFORMATION SHEET

E. Utility knife — Used to cut expansion material

EXAMPLE:

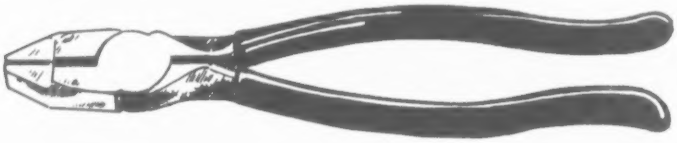
FIGURE 25



F. Side-cut pliers — Used to cut and twist wires on reinforcing steel and on forms

EXAMPLE:

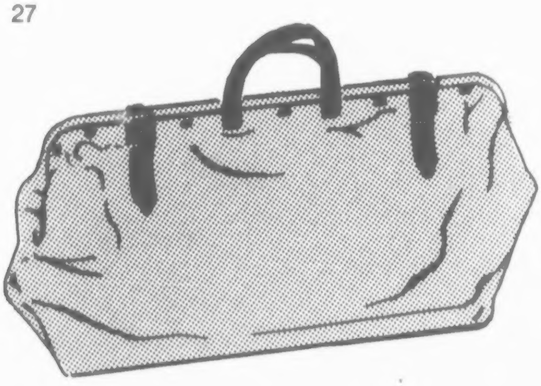
FIGURE 26



G. Tool bag — Used to store and transport tools

EXAMPLE:

FIGURE 27

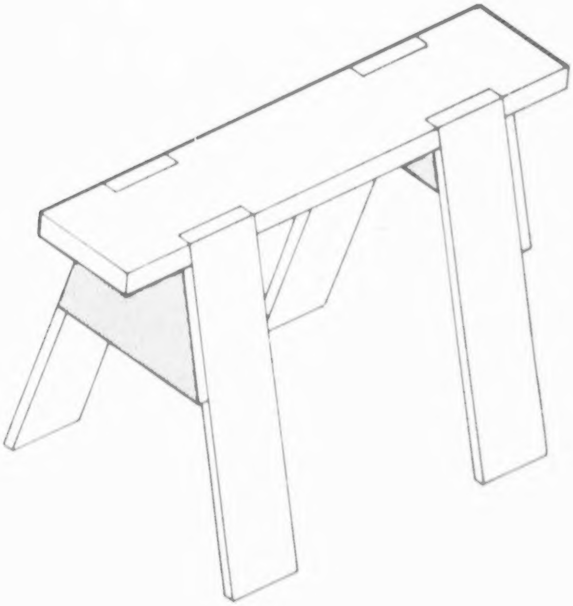


INFORMATION SHEET

H. Sawbuck (sawhorse) — Used to support lumber while cutting

EXAMPLE:

FIGURE 28



FORMING TOOLS
UNIT I

JOB SHEET #1 — SET AND DRIVE NAILS WITH A NAIL HAMMER

I. Tools and equipment

  A. Nail hammer (curved-claw or straight-claw hammer)

  B. Nails

  C. Two pieces of wood

  D. Firm, steady work surface

II. Procedure

  A. Check hammer to be sure that it is in good condition and handle is tight

  B. Place two pieces of wood one on top of the other on work surface (See Figure 30)

  C. Hold nail upright on top piece of wood with one hand (See Figure 30)

  D. Set nail, using the following guidelines

    1. Grasp hammer firmly near end of handle (See Figure 29)

    2. Rest face of hammer on nailhead (See Figure 30)

    3. Lift hammer and then give nail a light tap (Figure 30)

FIGURE 29

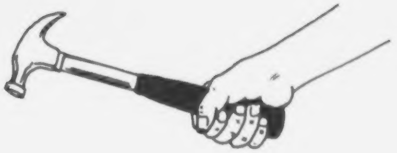
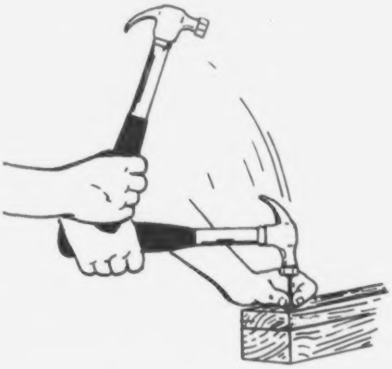


FIGURE 30



JOB SHEET #1

E. Drive nail, using the following guidelines

   1. Strike nail squarely with firm, smooth swing of hammer

      (NOTE: Deliver blows smoothly and evenly, using wrist, elbow, and/or shoulder—one or all are brought into action depending on the required force of the blow to be struck.)

   2. Avoid marring wood or bending nail

   3. If nail bends, pull it out and start again

   4. Continue driving nail until it penetrates top piece of wood, but stop before it enters bottom piece of wood

F. Following the procedures in Steps D and E, continue practicing until you can set and drive nails without bending them

G. Clean work area, and properly store tools and equipment

FORMING TOOLS
UNIT I

JOB SHEET #2 — USE A CROSSCUT HAND-SAW

I. Tools and equipment

  A. Crosscut hand-saw

  B. Square

  C. Pencil

  D. Piece of wood

  E. Sawhorse

II. Procedure

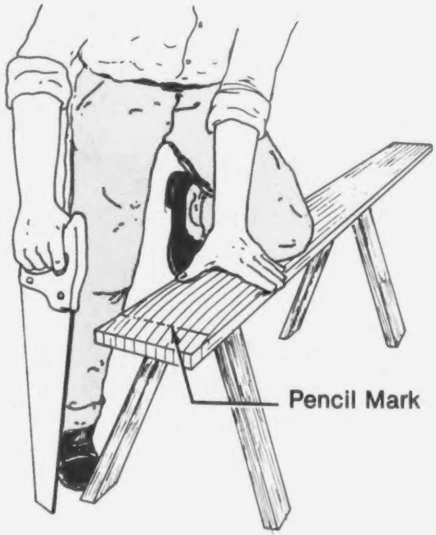
  A. Check saw to be sure it is sharp and in good condition

  B. Square and mark a pencil line across wood near one end (See Figure 31)

  C. Lay wood on sawhorse so that pencil mark extends past end of sawhorse (See Figure 31)

  D. Place one knee on top of wood to hold it firmly in place on sawhorse; grasp saw in one hand (Figure 31)

FIGURE 31

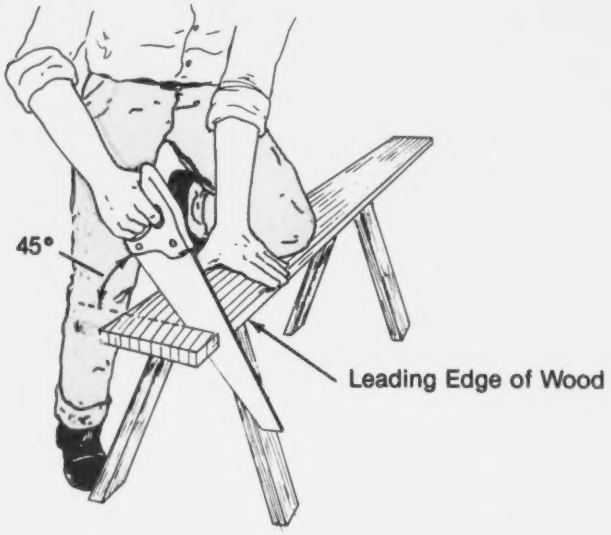


JOB SHEET #2

E. Start and complete cut, using the following guidelines

1. Place saw on leading edge of wood at pencil mark (See Figure 31)
2. Slide your thumb next to blade to steady blade and hold it on pencil mark
3. Draw saw backward and then push saw forward to start cut, holding saw at about a 45-degree angle from surface of wood (Figure 32)

FIGURE 32



4. Draw saw backward, holding blade square to piece of wood
5. Continue forward-and-backward motions until wood is cut through

(NOTE: Do not force, twist, or bend saw as this will damage the blade.)

F. Clean work area, and properly store tools and equipment

FORMING TOOLS
UNIT I

JOB SHEET #3 — USE A HACKSAW

I. Tools and equipment

   A. Steel tape or folding rule

   B. Soapstone

   C. Bench vise with soft jaws

   D. Hacksaw

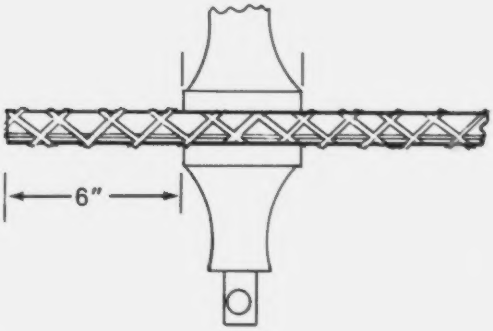
   E. 1-inch reinforcing rod, 36 inches long

   F. File

II. Procedure

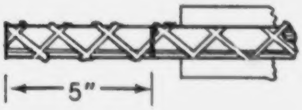
   A. Clamp reinforcing rod in bench vise so that about 6 inches extend past edge of vise (Figure 33)

FIGURE 33



   B. Using either tape or rule and soapstone, measure and then mark rod at 5-inch point (Figure 34)

FIGURE 34

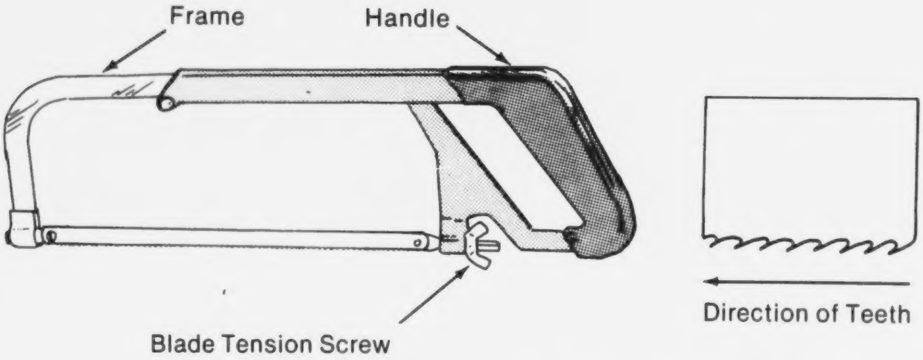


JOB SHEET #3

C. Check hacksaw to make sure that blade is tight, and that teeth are sharp and going in the right direction (Figure 35)

(NOTE: For most general-purpose work, use a blade that has twelve teeth per inch; however, a fine-toothed blade should be used to cut thin metal. When selecting saw blades, keep in mind the three-tooth rule—at least three teeth in contact with work.)

FIGURE 35



D. Put saw blade on soapstone mark

E. Hold saw firmly by handle and front of frame

F. Cut with a forward-and-backward movement, making about forty strokes per minute; apply pressure on forward strokes, and lift saw slightly on return strokes

(NOTE: Cut on forward movement only, and use the entire length of blade.)

CAUTION

When the saw is about to cut through the stock, ease up on the pressure. Otherwise, you may push your hand into the sharp edge of the piece still held in the vise.

G. Use file to deburr cut end of both pieces of reinforcing rod

H. Clean work area, and properly store tools and equipment

FORMING TOOLS
UNIT I

JOB SHEET #4 — USE PORTABLE CIRCULAR SAW TO PERFORM STRAIGHT AND ANGLE CUT-OFF OPERATIONS

I. Tools and equipment

  A. Safety goggles

  B. Portable circular saw

  C. Adjustable circular-saw protractor

  D. Folding rule or steel tape

  E. Combination square

  F. Pencil

  G. Extension cord

  H. Sawhorse

  I. One piece of 2×4 about 4 feet long

II. Procedures

  A. Straight cut

    1. Check to see that all safety devices are in place

    2. Check to see that automatic blade guard is free and retractable

    3. Check blade to be sure it is sharp and not damaged

    4. Adjust blade so that it is slightly lower than thickness of material being cut

    5. Measure and mark 2×4 at proper length (given by instructor)

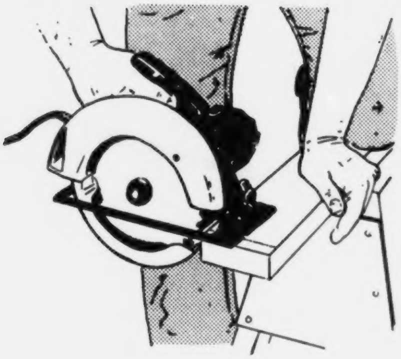
    6. Plug saw into power source, making sure that saw is grounded

    7. Put on safety goggles

    8. Hold 2×4 securely on sawhorse, and align saw blade properly with mark on 2×4 (See Figure 36)

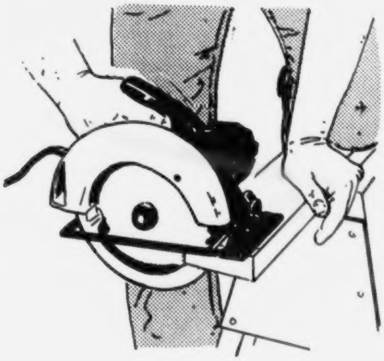
JOB SHEET #4

FIGURE 36



9. Check with instructor for approval before starting saw
10. Check to be sure that blade is clear of stock before starting saw
11. Start saw and let it gain maximum speed
12. Hold 2×4 securely as you advance saw blade into work slowly but firmly (Figure 37)

FIGURE 37



JOB SHEET #4

13. Turn off saw immediately after cut is made
14. Be sure that blade guard has returned to its proper position
15. After blade has stopped turning, lay saw on its side
16. Discard scrap in proper receptacle
17. Unplug saw from power source

    (NOTE: If angle cut is to be made immediately, it will not be necessary to unplug saw from power source or to repeat Steps 1 through 4 under straight-cut procedures.)

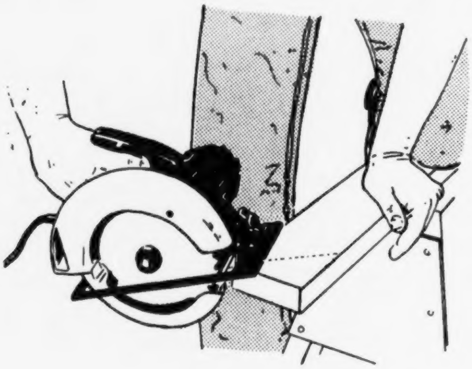
18. Remove safety goggles

B. Angle cut

1. Measure and mark angle on 2×4 at proper length (angle and length given by instructor)
2. Put on safety goggles
3. Hold 2×4 securely on sawhorse, and align saw blade properly with mark on 2×4 (Figure 38)

   (NOTE: The adjustable protractor may be used to assist in making a more accurate cut.)

FIGURE 38



JOB SHEET #4

4. Check with instructor for approval before starting saw
5. Check to be sure that blade is clear of stock before starting saw
6. Start saw and let it gain maximum speed
7. Hold 2×4 securely as you advance saw blade into work slowly but firmly
8. Turn off saw immediately after making cut
9. Be sure that blade guard has returned to its proper position
10. After blade has stopped turning, lay saw on its side
11. Discard scrap in proper receptacle
12. Unplug saw from power source
13. Remove safety goggles
14. Clean up area, and properly store tools and equipment

FORMING TOOLS
UNIT I

JOB SHEET #5 — USE FRAMING SQUARE AND RULE TO LAY OUT A SQUARE CORNER

I. Equipment and materials

   A. Framing square

   B. Pencil

   C. Rule

   D. Chalk line

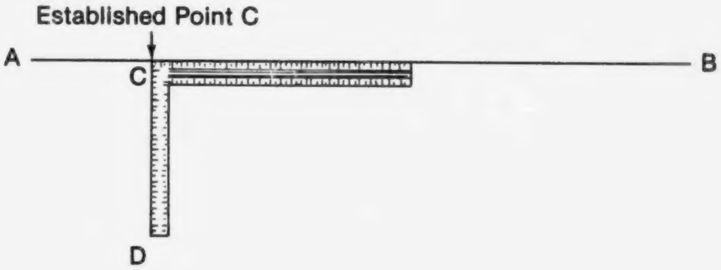
II. Procedure

   A. Place framing square on Point C to square off a line (See Figure 39)

   (NOTE: Instructor will establish Point C.)

   B. Mark Line CD along edge of framing square to establish square corner (See Figure 39)

FIGURE 39

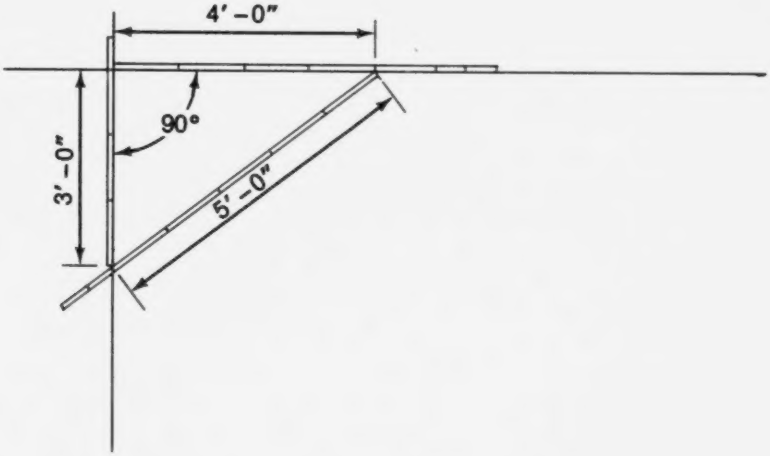


   C. Snap a chalk line from Point C along Line CD to extend several feet past Point D

JOB SHEET #5

D. Use rule and 3-4-5 method to check square of corner (Figure 40)

FIGURE 40



E. Recheck work

F. Clean work area, and properly store equipment and materials

FORMING TOOLS
UNIT I

JOB SHEET #6 — USE A LEVEL

I. Equipment and materials

   A. 4-foot spirit level

   B. Vertical and horizontal work surfaces

   C. Pencil

   D. Tape

   E. Straightedge

II. Procedure for leveling

   A. Check level for accuracy

   (NOTE: Levels are very delicate instruments and must be handled carefully to ensure accuracy. Levels should be checked for accuracy before use, especially if the instrument has been dropped or jarred.)

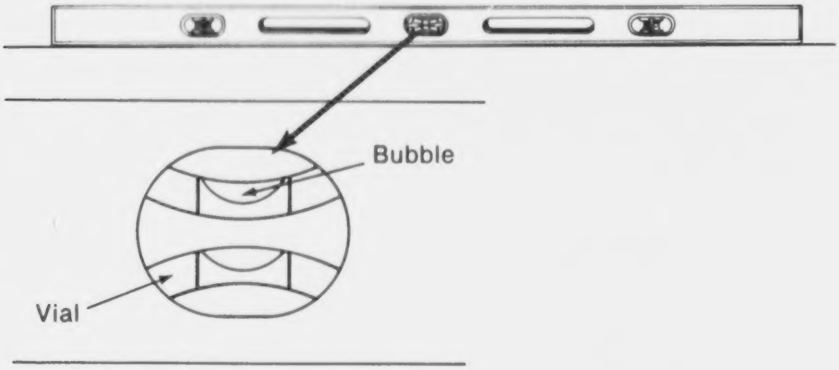
   1. Set base of level on flat, horizontal surface

   2. Check bubble position in horizontal vial

   3. Adjust surface or location of level until bubble is centered; mark position on surface

      (NOTE: On a level surface, the bubble will lie evenly positioned between the lines on the vial. See Figure 41.)

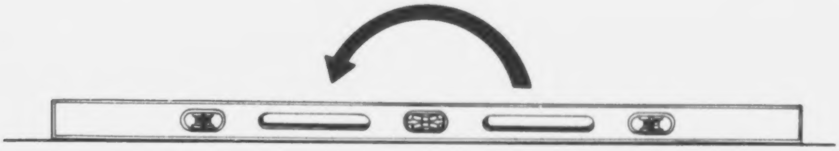
FIGURE 41



JOB SHEET #6

4. Rotate the level end for end and position it on the exact location of bubble-centered reading (Figure 42)

FIGURE 42



5. Check bubble position in the horizontal vial

   (NOTE: The bubble will be centered from this side also if the level is accurate.)

6. Replace or repair level as necessary

B. Level a surface

1. Visually check surface for irregularities and foreign matter such as dirt

   (NOTE: Even small surface irregularities or particles can cause inaccurate readings.)

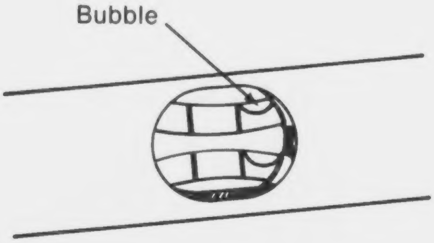
2. Clean or replace surface as necessary

3. Set base of level carefully and squarely on surface

4. Check bubble position

   (NOTE: The bubble will be displaced toward the high end of the level. See Figure 43)

FIGURE 43



JOB SHEET #6

5. Adjust surface as necessary

6. Take additional readings to level surface as required

   (NOTE: Many factors, such as the type of surface and the material being used, affect the number of readings that are required.)

III. Procedure for plumbing

A. Check level for accuracy

1. Place base of level against flat, vertical surface (See Figure 44)

2. Check bubble position in upper horizontal vial

3. Adjust surface or location of level until bubble is centered; mark position on surface

4. Rotate level end for end and position it on the exact location as that of the bubble-centered reading (Figure 45)

FIGURE 44

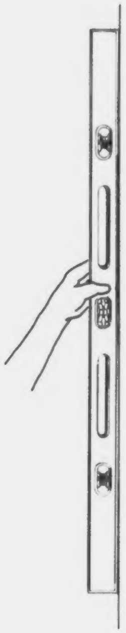
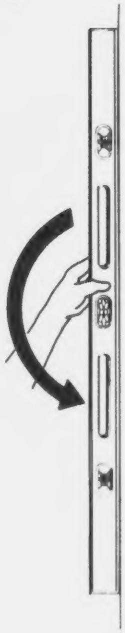


FIGURE 45



JOB SHEET #6

5. Check bubble position in the upper horizontal vial

   (NOTE: The bubble will be centered at this end also if level is accurate.)

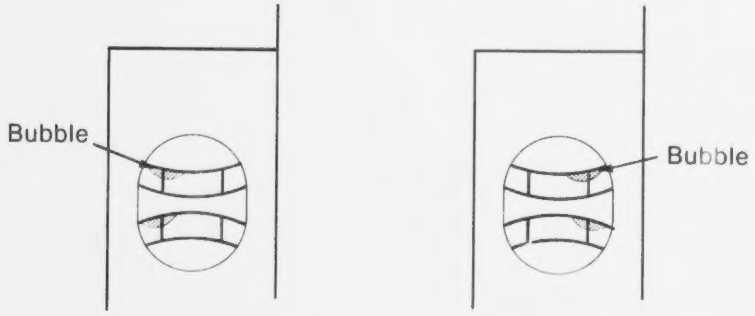
6. Replace or repair level as necessary

B. Plumb a surface

1. Visually check surface for irregularities and foreign matter such as dirt
2. Clean or replace surface as necessary
3. Place base of level carefully and squarely against surface
4. Check bubble position in upper vial

   (NOTE: The bubble will move toward one end of the vial if the surface is not plumb. To plumb the surface, you must adjust it in the direction of bubble displacement. See Figure 46.)

FIGURE 46



Surface slants /　　Surface slants \

5. Adjust surface as necessary
6. Take additional readings to plumb as required

C. Clean work area, and properly store equipment and materials

FORMING TOOLS
UNIT I

TEST

NAME ______________________________ SCORE ______________

1. Match terms and definitions associated with forming tools. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a. Tool or device attached to a string; used to set and check the vertical or perpendicular of a surface

1. Leveling rod
2. Stake
3. Plumb bob

_____b. Soft stone used for marking

1. Stake
2. Soapstone
3. Square

_____c. To saw wood with the grain

1. Rip
2. Crosscut
3. Square

_____d. Pointed piece of wood or metal driven into ground and used to hold forms in place

1. Stake
2. Grade
3. Soapstone

_____e. Pole with markings graduated upward from zero; used with leveling instrument to determine elevations

1. Stake
2. Square
3. Leveling rod

_____f. Method of squaring a line by forming a right triangle using largest multiple of 3-4-5 possible for length of lines being squared, and ensuring that longest side of triangle is exact appropriate multiple of 5

1. Squaring method
2. 3-4-5 method
3. Crosscut method

_____g. Given grade

1. Plumb bob
2. Elevation
3. Grade

TEST

_____h. Given elevation to which forms are set

1. Elevation
2. Grade
3. Square

_____i. To saw wood across the grain

1. Rip
2. Crosscut
3. Square

_____j. To form a right angle; 90 degrees to a straight line

1. Grade
2. Square
3. Crosscut

2. State six rules for care and safe use of hand tools.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

3. State four rules for safe use of portable circular saws.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

4. State rules for proper care of leveling instruments.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

TEST

5. Match types of hammers to their correct uses. Write the correct numbers in the blanks.

_____a. Used to drive and pull nails

_____b. Used to drive stakes and break concrete

_____c. Used to drive nails, pull nails, dismantle, and wreck

1. Curved-claw hammer
2. Straight-claw hammer
3. Sledgehammer

6. Match types of saws to their correct uses. Write the correct numbers in the blanks.

_____a. Used to cut across the grain of wood

_____b. Used to cut with the grain of wood

_____c. Used to rip and crosscut form material

_____d. Used to cut metal

1. Rip hand-saw
2. Hacksaw
3. Crosscut hand-saw
4. Portable power circular saw

7. Match types of squares to their correct uses. Write the correct numbers in the blanks.

_____a. Used to check squareness and to lay out 45-degree angles

_____b. Used to square corners, check squareness, and lay out 90-degree angles

1. Combination square
2. Framing square

8. Match types of measuring tools to their correct uses. Write the correct numbers in the blanks.

_____a. Used to measure irregular as well as regular shapes and to make accurate inside and outside measurements

_____b. Used to make accurate inside and outside measurements for laying out forms, laying out joints, and checking for square

1. Flexible steel tape
2. Folding rule (zigzag rule)

TEST

9. Match types of leveling instruments to their correct uses. Write the correct numbers in the blanks.

______a. Used to level forms and to transfer and check grades

______b. Used to check grades on short forms such as step treads

______c. Used to check elevations and to transfer and check grades

______d. Used to check grades of a dry line

______e. Used to set and check elevations

______f. Used to establish and check elevations and to establish, check, and transfer grades

1. Builder's level (with plumb bob)
2. Water level
3. Spirit level
4. Laser-beam level (with leveling rod)
5. Line level
6. Torpedo level

10. Match miscellaneous forming tools and equipment to their correct uses. Write the correct numbers in the blanks.

______a. Used as a guide to set stakes and forms straight and accurately

______b. Used to cut expansion material

______c. Used to pull nails, to pry, and to remove forms

______d. Used to support lumber while cutting

______e. Used to drive short masonry nails through expansion material and into masonry walls when setting expansion material

______f. Used to lay out work on concrete, to lay out cut lines on lumber, and to mark joints in concrete

______g. Used to store and transport tools

______h. Used to cut and twist wire on reinforcing steel and on forms

1. Utility knife
2. Chalk box and line
3. Sawbuck (sawhorse)
4. Line (string line; dry line)
5. Ripping bar (wrecking bar)
6. Magnetic nail driver
7. Side-cut pliers
8. Tool bag

TEST

(NOTE: Test item 11 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

11. Demonstrate the ability to

    a. Set and drive nails with a nail hammer.

    b. Use a crosscut hand-saw.

    c. Use a hacksaw.

    d. Use a portable circular saw to perform straight and angle cut-off operations.

    e. Use framing square and rule to lay out a square corner.

    f. Use a level.

FORMING TOOLS
UNIT I

ANSWERS TO TEST

1. a. 3
   b. 2
   c. 1
   d. 1
   e. 3
   f. 2
   g. 2
   h. 2
   i. 2
   j. 2

2. Answer should include any six of the following.

   a. Use the correct tool for the job
   b. Keep tools clean
   c. Keep tools dry
   d. Keep tools sharp
   e. Inspect tools frequently to make sure they are in good condition
   f. Repair broken or damaged tools promptly
   g. Dispose of broken tools that cannot be repaired
   h. *Do not* use broken tools
   i. *Do not* throw tools
   j. Protect cutting edge of tools when carrying and storing
   k. Store tools properly when not in use
   l. Wear eye protection when appropriate
   m. Stay alert when using hand tools

3. Answer should include any four of the following.

   a. Keep electric cord clear of blade to avoid cutting cord
   b. Be sure that automatic guard is free and retractable
   c. Check stock for nails and any other metal before cutting
   d. Use a good, solid support for stock while cutting
   e. Allow saw to gain maximum speed before starting cut
   f. Set blade only deep enough to cut through stock
   g. Lay saw on its side after finishing the cut

4. a. Protect instrument from shock and vibration
   b. *Never* force screws or other moving parts of the instrument
   c. Loosen leveling screws before returning instrument to carrying case
   d. Carry tripod under your arm with the instrument in front of you

5. a. 1
   b. 3
   c. 2

ANSWERS TO TEST

6. a. 3
b. 1
c. 4
d. 2

7. a. 1
b. 2

8. a. 1
b. 2

9. a. 3
b. 6
c. 1
d. 5
e. 2
f. 4

10. a. 4
b. 1
c. 5
d. 3
e. 6
f. 2
g. 8
h. 7

11. Performance skills evaluated to the satisfaction of the instructor.

HAND TOOLS
UNIT II

UNIT OBJECTIVE

After completing this unit, the student should be able to identify various hand tools and state specific uses for hand tools used for placing and finishing fresh concrete. The student should also be able to state guidelines for the care and safe use of hand tools. The student will show this ability by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms and definitions associated with hand tools.
2. State guidelines for care and safe use of hand tools.
3. State specific uses of hand tools used for placing and finishing fresh concrete.
4. Identify hand tools used for placing and finishing fresh concrete.
5. Label hand tools used for patching and mixing concrete.
6. Label hand tools used for working with hardened concrete.
7. Label miscellaneous hand tools and equipment.
8. Demonstrate the ability to
   a. Use a bull float.
   b. Use a hand float and a finishing trowel.
   c. Use an edger.
   d. Dress edges of a finishing trowel.

HAND TOOLS
UNIT II

SUGGESTED ACTIVITIES

I. Unit contents

- A. Objective sheet
- B. Suggested activities
- C. Supplement #1 — Hand Tools Crossword Puzzle
- D. Information sheet
- E. Job sheets
    - 1. Job Sheet #1 — Use a Bull Float
    - 2. Job Sheet #2 — Use a Hand Float and a Finishing Trowel
    - 3. Job Sheet #3 — Use an Edger
    - 4. Job Sheet #4 — Dress Edges of a Finishing Trowel
- F. Test
- G. Answers to test

II. Instructor's guide

- A. Review unit and plan presentation.
- B. Obtain materials to supplement unit.
    - 1. Audiovisual presentations

      (NOTE: Presentations "a," "b," and "c" are available from the Portland Cement Association, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077. Presentation "d" is available from the Portland Cement Association at the same address; however, it is also available from the American Concrete Institute, P.O. Box 19150, Redford Station, Detroit, Michigan 48219.)

        - a. *Concrete Tools and Finishing*. 50 color slides, Portland Cement Association, 1974.

SUGGESTED ACTIVITIES

   b. *Quality Concrete Slide Reference File III*. 362 color slides, Portland Cement Association, 1980.

      (NOTE: This slide set includes fifteen individual chapters or groups of slides, any one of which may be purchased separately. These slides illustrate typical tools, equipment, and techniques used to produce quality concrete.)

   c. *Finishing and Curing Quality Concrete*. Color, 27 minutes, available in either 16mm film or as a video cassette. Portland Cement Association, 1976.

      (NOTE: This presentation illustrates the recommended practices for finishing and curing quality concrete and for producing attractive and durable concrete surfaces.)

   d. *Finishing Concrete Flatwork*. Color, 31 minutes, available in ¾-inch cassette, ½-inch VHF, or ½-inch Betamax. American Concrete Institute, n.d.

      (NOTE: This video cassette identifies tools and their basic uses. Check with your local AGC or ACI organization before ordering this presentation from the national organization, as some of the local organizations have this presentation and will show it for you or loan it to you so that you can show it yourself.)

2. Tool catalogs

   (NOTE: Order catalogs from the following companies at the addresses listed.)

   a. Goldblatt Tool Company, 511 Osage, P.O. Box 2334, Kansas City, Kansas 66110

   b. Marshall Town Trowel Company, P.O. Box 738 Marshalltown, Iowa 50158

   c. Masonry Specialty Company, 4430 Gibsonia Road (Rt. 910), Gibsonia, Pennsylvania 15400

3. Samples of all the tools to be discussed in conjunction with this unit

4. Materials needed for tool demonstrations

5. Materials needed for job sheets

6. Competency profiles

SUGGESTED ACTIVITIES

(NOTE: Competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

C. Introduce unit to students.

SUGGESTIONS:

- Show selected portions from the audiovisual presentation *Quality Concrete Slide Reference File III*.
- Discuss hand tools, pointing out the importance of buying good grades of tools. Tell students that quality not price should be their main concern when purchasing tools. Also warn students that there are many different types and styles of each kind of tool and that there are specialized tools for specific jobs and uses. Impress on students that they should not run right out and purchase a bunch of tools without really knowing what tools they will be using on the job.
- Display tool catalogs and ask students to review.

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, emphasizing the care and safe use of hand tools.

F. Provide students with information and job sheets.

G. Discuss information and job sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with hand tools.

   SUGGESTIONS:

   - Discuss and demonstrate terms that may be unfamiliar to the students.
   - Provide actual samples when possible.

2. Use Information Sheet, Section II, to discuss guidelines for care and safe use of hand tools.

   SUGGESTIONS:

   - Have students review Section A, Unit V, "Safety and Basic First Aid."

SUGGESTED ACTIVITIES

- Reemphasize the importance of buying quality tools. Explain how good care will preserve the tools so that they will last for many years.
- Discuss how safe and proper use of tools will save tools and prevent accidents.
- Emphasize that carelessness in handling long-handled tools such as bull floats and rollerbugs can be very dangerous to others working around you.
- Have students explain details of accidents they know of when someone used tools improperly.
- Discuss newspaper clippings or case studies that relate to improper use of tools.
- Demonstrate to students how to clean and store tools properly.
- Demonstrate how the quality and quantity of work increases when using tools in good condition compared to using tools in poor condition.
- Explain your policy for replacement and repair of damaged tools.
- Outline your tool-management system for shop and job site.
- Caution students about fresh concrete: Fresh concrete can cause skin irritation and possible cement poisoning. Stress the importance of wearing protective clothing and rubber gloves when working with fresh concrete.

3. Use Information Sheet, Sections III and IV, to discuss types of hand tools used for placing and finishing fresh concrete and their specific uses.

SUGGESTIONS:

- Show one of the following audiovisual presentations: *Concrete Tools and Finishing*, *Finishing and Curing Quality Concrete*, or *Finishing Concrete Flatwork*. Then discuss each type of tool listed below.

Shovels

- Display common shovels for students to identify and become familiar with.
- Explain and demonstrate how concrete is placed and puddled with a shovel. Then let students repeat the demonstration.
- Observe and correct student demonstrations as necessary.

SUGGESTED ACTIVITIES

Straightedges

- Display as many straightedges as practical for the students to identify and become familiar with.

- Explain and promote discussion of the specific use of all straightedges: to rod concrete surface to a given grade.

- Demonstrate the use of each type of straightedge, and then let the students repeat the demonstrations so that they may "get the feel" of the various types.

- Observe the student demonstrations and correct procedures as necessary.

Darbies

- Display as many darbies as practical for the students to identify and become familiar with.

- Explain and promote discussion of the specific use of all darbies: to darby concrete surface to eliminate any high or low spots left after the rodding process.

- Demonstrate the use of each type of darby you have displayed, and then let the students repeat the demonstrations.

- Observe student demonstrations and correct procedures as necessary.

Bull floats

- Display as many bull floats as practical for the students to identify and become familiar with.

- Explain and promote discussion of the specific use of all bull floats: to float large concrete surfaces to eliminate any high or low spots or ridges left after the rodding process.

- Explain the use of each type of bull float.

  —Explain that if all bleeding has ceased, a magnesium or aluminum bull float will tend to seal the surface of lightweight, air-entrained concrete. Sealing the surface can be a good factor on hot, dry, windy days when the concrete may set too fast otherwise.

  —Explain how wood bull floats tend to open the surface of non-air-entrained concrete, which can be a good factor on cool days when the concrete may set too slowly otherwise.

SUGGESTED ACTIVITIES

- Demonstrate the procedures in Job Sheet #1, "Use a Bull Float," showing students how the bull-float handle will need to be lowered to raise the leading edge of the bull float on the forward stroke and then raised to raise the leading edge on the backward stroke. Also explain that, when possible, bull floating should be done perpendicular to the direction of the straightedging process. If bull floating in the same direction as the straightedging process, the bull float tends to dish into the concrete surface, but bull floating perpendicular to the straightedging process will flatten any ridges that were left by the straightedge.

  (NOTE: You may want to demonstrate the use of the bull float on wet sand rather than on fresh concrete. Even though the wet sand will not act exactly like fresh concrete, it is a good substitute for fresh concrete and is certainly much more economical to use for demonstration and practice.)

- Caution students to stay alert when using a bull float. The bull float has a long handle, so everyone and everything behind the student must be clear before using the bull float. Also caution students to use only OSHA-approved bull floats with insulated handles.

- Have students complete Job Sheet #1.

Tampers

- Display as many tampers as possible for the students to identify and become familiar with.

- Explain and promote discussion of the specific use of all tampers: to embed coarse aggregate just below concrete surface and to consolidate surface. Stress that tampers are used only on low-slump concrete.

- Discuss uses of various types of tampers, pointing out that jitterbugs and rollerbugs should be used only on low-slump (1 inch or less) concrete and that hand tampers, which are seldom used, are only used on very stiff (no slump) concrete.

- Demonstrate the use of each type of tamper you have displayed, and then let the students repeat the demonstrations so that they may "get the feel" of the various tampers. Caution students not to overwork the concrete when using a tamper.

- Observe student demonstrations and correct procedures as necessary.

Edgers

- Display various types and sizes of edgers as practical for the students to identify and become familiar with.

SUGGESTED ACTIVITIES

- Explain and promote discussion of the specific use of all edgers: to form a radius at concrete-slab edges to improve appearance and reduce risk of damage to edges.
- Demonstrate the procedures in Job Sheet #3, "Use an Edger." Have students practice the procedures in Job Sheet #3. Observe students and correct procedures as necessary.
- Have students complete Job Sheet #3.

Jointers

- Display various types and sizes of jointers (groovers) as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all jointers: to cut joints partly through fresh concrete to act as controls to predetermine location of possible cracks and to improve appearance.
- Demonstrate the use of each type of jointer you have displayed, and then let the students repeat the demonstrations so that they may "get the feel" of the various jointers.
- Observe student demonstrations and correct procedures as necessary.

Hand floats

- Display various types and sizes of hand floats as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use for all hand floats: to float concrete around hard-to-reach places and to prepare concrete surface for troweling.
- Discuss the different types of materials used to make hand floats.

EXAMPLES: Redwood, teak, bodar, white pine, mahogany, yellow poplar, laminated canvas-resin, aluminum, magnesium, steel, cork, sponge/rubber, and carpet.

- Discuss the use of each type of hand float.

—Wood, magnesium, aluminum, and steel floats are used on floor slabs to finish fresh concrete.

—Cork, rubber, and carpet floats are usually used on vertical surfaces to finish concrete. Each of the different soft-faced floats creates a different finished texture on the concrete.

SUGGESTED ACTIVITIES

Trowels

- Display various types of hand trowels as practical for the students to identify and become familiar with.
- Explain and promote discussion of the specific use of all hand trowels: to give concrete surface a dense, smooth finish.
- Discuss the use of the various types of trowels.
  - —Finishing trowels are used to lay down and finish concrete. Larger, wider trowels are used on wet concrete.
  - —Fresno trowels are used for lay-down work and in hard-to-reach areas.
  - —Midget trowels are used on small areas such as windowsills, curbs, walls, steps, and such.
  - —Pipe trowels are used around pipes, forms, and equipment where other trowels will not fit.
- Demonstrate the procedures in Job Sheet #2, "Use a Hand Float and a Finishing Trowel."
- Allow students to practice the procedures in Job Sheet #2. Observe students and correct procedures as necessary.
- Have students complete Job Sheet #2.
- Demonstrate the procedures in Job Sheet #4, "Dress Edges of a Finishing Trowel."
- Allow students to practice the procedures in Job Sheet #4. Observe students and correct procedures as necessary.
- Have students complete Job Sheet #4.

Combination tools

- Display various types of combination tools as practical for the students to identify and become familiar with.
- Discuss the various types of combination tools, and then give each student a set of tools and the descriptive name of the set. Have students attempt to demonstrate how the tool should be used. If they use the tool incorrectly, stop them, and then show students the proper use of the tool.

SUGGESTED ACTIVITIES

EXAMPLE: Hand a student a cove-and-base tool set and ask him or her to attempt to use it. If the student is unable to use it correctly, stop him or her and explain that the tool should ride with one side on the floor and the other side on the base. When the mortar is applied, the tool will form the base and the cove at the same time. The spoon is used to help form the corners where the base tool will not work, and it is also used to wipe out any blemishes that may occur on the base after the final finishing.

- Demonstrate the use of each of the combination tools, and then let the students repeat the demonstration.
- Observe student demonstrations and correct procedures as necessary.

4. Use Information Sheet, Section V through VII, to discuss hand tools used for patching and mixing concrete, for working with hardened concrete, and miscellaneous hand tools and equipment.

   SUGGESTIONS:

   - Display the various types of tools illustrated in these sections of the information sheet.
   - Discuss their general uses, and then demonstrate their uses.
   - During demonstrations, give the students any pertinent information they may need to know about specific tools.

   EXAMPLES: Explain how the different grit sizes on rubbing stones will produce a different texture on the surface of the concrete. Caution students about premature rubbing of the concrete because if the concrete has not set long enough, the stone will loosen and pull out the surface aggregate and the protective surface of the concrete.

5. Display selected tools from all the sections of the information sheet and label each with a letter of the alphabet. Have each of the students see how many of the tools they are able to identify and explain the use of.

6. Have students complete Supplement #1, "Hand Tools Crossword Puzzle."

H. Give test.

I. Critique test and discuss in class.

J. Reteach and retest as necessary.

K. Complete appropriate section of competency profiles.

SUGGESTED ACTIVITIES

III. Unit references

A. *Goldblatt Tool Company Tool Catalog*. Kansas City, Kansas: Goldblatt Tool Company, 1983.

B. Hendrix, Laborn J. "Bud". *Fundamentals of Carpentry*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of American, 1985.

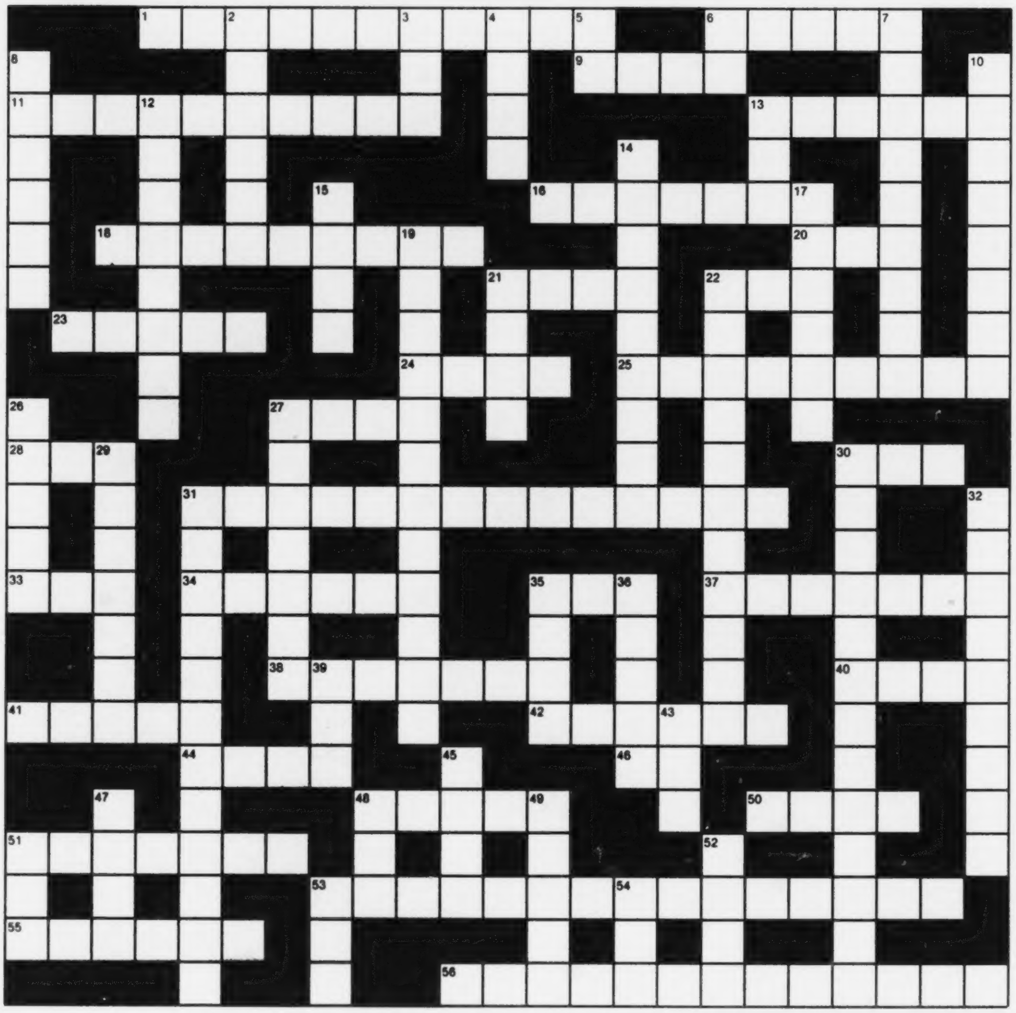
C. Polivchak, Philip, and Gilbert Wolf. *Incentive Apprenticeship Training for Cement Masons—Learning Packets*. Washington, D.C.: National Association of Home Builders and the United States Department of Labor, 1979.

D. *Sellstrom Safeguards Catalog No. SW44*. Palatine, Illinois: Selstrom Manufacturing Company, 1975.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — HAND TOOLS CROSSWORD PUZZLE

Use the information sheet and the clues on the following page to complete the crossword puzzle below.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SUPPLEMENT #1

ACROSS

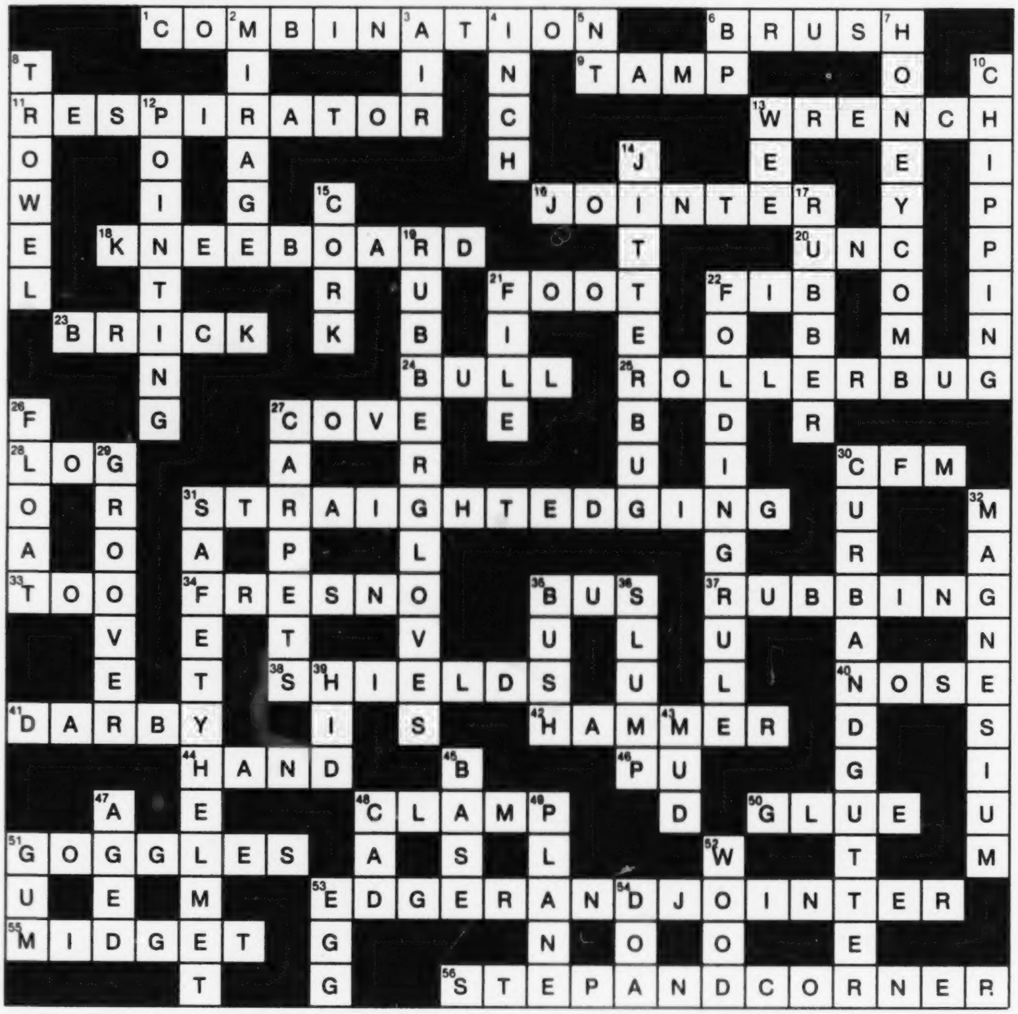
1. Type of tool designed to do at least two jobs
6. Tool used in finishing and rubbing operations
9. Tool used to consolidate very low-slump concrete
11. Equipment worn over nose and mouth to prevent inhalation of dusts or mists
13. Tool used for holding and turning nuts, bolts, pipes, etc.
16. Tool used to cut grooves in concrete
18. Equipment used to kneel on while finishing flatwork
20. Uncle (slang)
21. Twelve inches
22. Lie (slang)
23. Hard, red building material
24. Type of float used during process of leveling concrete to eliminate any high or low spots or ridges left after rodding process
25. Largest type of tamper
27. Concave or radius at bottom section of curb, step, or base
28. Cut section of tree trunk or limb
30. Abbrev. for cubic feet per minute
31. Process of rodding concrete surface to a given grade
33. Also
34. Type of trowel fitted with a long handle
35. Vehicle that can carry many passengers
37. Type of stone used to dress down hardened concrete surface
38. Transparent protective devices worn over the face
40. Organ of smell
41. Tool used to eliminate high or low spots or ridges left by rodding process
42. For example 10 down
44. Type of float used to prepare concrete surface for troweling
46. It stinks (slang)
48. Device used to hold work in place
50. Material used to stick things together
51. Type of eye protection
53. Combination tool used for edging and jointing
55. Type of trowel
56. Type of combination tool

DOWN

2. Optical illusion
3. Pneumatic power
4. One-twelfth of a foot
5. Abbrev. for "not there"
6. Abbrev. for "ballpark"
7. Cavity or pit in concrete
8. For example 12 down
10. Type of hammer used to cut off projections on hardened concrete
12. Type of trowel used to patch holes, grout base, and clean other tools
13. Tiny
14. Type of tamper
15. Special type of float used to create special finishes on rubbed concrete
17. Another special type of float
19. Type of hand protection
21. Tool used to dress edges of trowels
22. Tool used for measuring
26. For examples 15 and 17 down
27. Materials used to make a special type of float used to create special finishes on rubbed concrete
29. Another term for "jointer"
30. Combination tool
31. Head protection
32. Metal used for certain floats
35. Type of hammer used to create a rough, colorful finish
36. Consistency of concrete
39. Past tense of "hide"
43. Wet earth
45. Bottom section of wall
47. Grew older
48. Abbrev. for cadmium
49. Tool used for shaving wood surface to make it smooth
51. Type of turpentine
52. Type of float
53. Typical American breakfast food
54. Abbrev. for "dead on arrival"

SUPPLEMENT #1

Solution to Puzzle


1 COMBINATION
6 BRUSH
9 TAMP
11 RESPIRATOR
13 WRENCH
16 JOINTER
18 KNEEBOARD
20 UNC
21 FOOT
22 FIB
23 BRICK
24 BULL
25 ROLLERBUG
27 COVE
28 LOG
30 CFM
31 STRAIGHTEDGING
33 TOO
34 FRESNO
35 BUS
37 RUBBING
38 SHIELDS
40 NOSE
41 DARBY
42 HAMMER
44 HAND
46 PU
48 CLAMP
50 GLUE
51 GOGGLES
53 EDGERANDJOINTER
55 MIDGET
56 STEPANDCORNER

HAND TOOLS
UNIT II

INFORMATION SHEET

I. Terms and definitions associated with hand tools

   A. Placing — Process of distributing concrete

   B. Finishing — Process of working concrete to desired texture

   C. Void — Empty space, gap

   D. Honeycomb — Void or cavity left in concrete due to ineffective consolidation

   E. Rod — To level concrete to a specific grade

   F. Float — To finish fresh-concrete surface by use of a float; precedes troweling when that is to be final finish

   G. Low-slump concrete — Concrete with a stiff consistency

   H. Patching — Process of filling form-tie holes, honeycombs, or any other defects in concrete

   I. Cove — Concave or radius at bottom section of curb, step, or base

   J. Base — Bottom section of a wall

II. Guidelines for care and safe use of hand tools

   A. Use the correct tool for the job

   B. Maintain tools properly

   C. Keep tools clean

   D. Inspect tools frequently to be sure they are in good condition

   E. Repair broken or damaged tools promptly

   F. Dispose of broken or damaged tools that cannot be repaired

   G. Store tools properly when not in use

   EXAMPLES: *Do not* carry tools in your pockets; *do not* leave tools lying around; protect edges of tools; store tools in a dry place.

   H. Wear eye, ear, and nose protection when necessary

   EXAMPLES: When rubbing; when applying dry shake to a slab; when using a ceiling grinder

INFORMATION SHEET

I. Stay alert when using tools

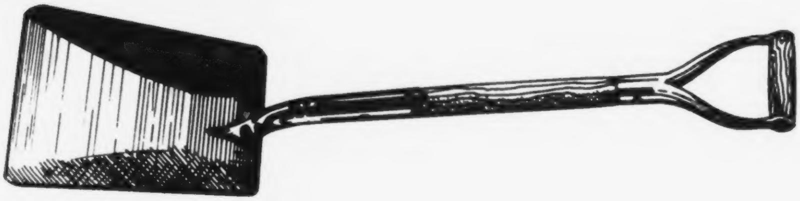
EXAMPLES: Keep fingers away from cutting edges; work away from your body when using cutting tools; use tools with insulated or wooden handles when working around electrical equipment; be sure everyone is clear when using long-handled tools such as bull floats and rollerbugs.

J. *Do not* throw tools

III. Specific uses of hand tools used for placing and finishing fresh concrete

A. Shovels — Used to place and puddle concrete alongside edge forms to prevent voids and honeycombing (Figure 1)

FIGURE 1



B. Straightedges — Used to rod concrete surface to a given grade

C. Darbies — Used to darby concrete surface to eliminate any high or low spots or ridges left after rodding process

D. Bull floats — Used on large concrete surfaces to eliminate any high or low spots or ridges left after rodding process

E. Tampers (tamps) — Used on low-slump (1 inch or less) concrete to embed coarse aggregate just below concrete surface and to consolidate concrete surface

F. Edgers — Used to form a radius at concrete-slab edges to improve appearance and reduce risk of damage to edges

G. Jointers (groovers) — Used to cut joints (grooves) partly through fresh concrete to act as controls to predetermine location of possible cracks and to improve appearance

(NOTE: Control joints do not extend completely through the slab but are cut to a depth one-fourth the thickness of the slab.)

INFORMATION SHEET

H. Hand floats — Used to float concrete around hard-to-reach places and to prepare concrete surface for troweling

I. Trowels — Used to give concrete surface a dense, smooth finish

J. Combination tools — Used to do at least two jobs at the same time

EXAMPLE: Edger/jointer

IV. Hand tools used for placing and finishing fresh concrete

A. Types of straightedges (Figures 2-5)

1. Common wood or magnesium straightedge

(NOTE: The common wood or magnesium straightedge is used to rod concrete after it has been placed. The common wood straightedge is generally made of 1 1/4-inch stock. The common magnesium straightedge is usually 1 inch thick and 4 1/2 inches wide. Straightedges come in lengths ranging from 3 to 16 feet, the length used depending on the distance between the edge forms. Both wood and magnesium straightedges can be used on the same types of jobs, but magnesium straightedges work better on some toppings, prevent drag, and are preferred as a guide when cutting joints.)

FIGURE 2

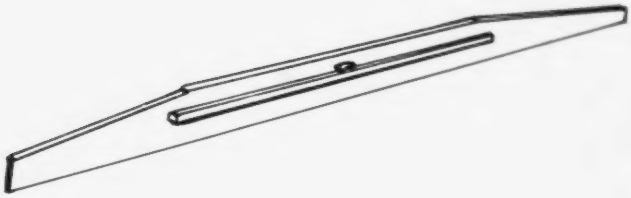
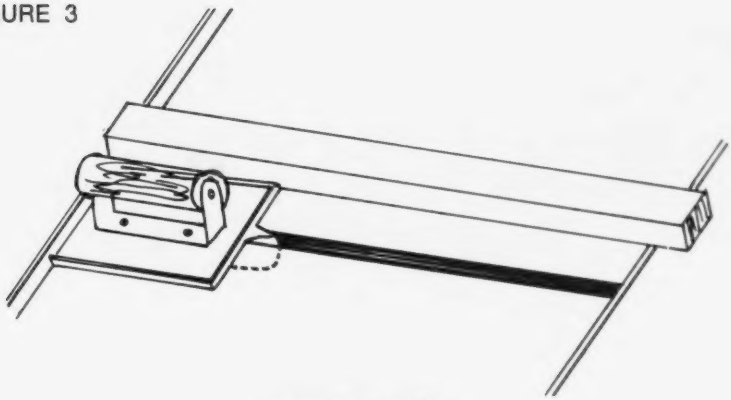


FIGURE 3

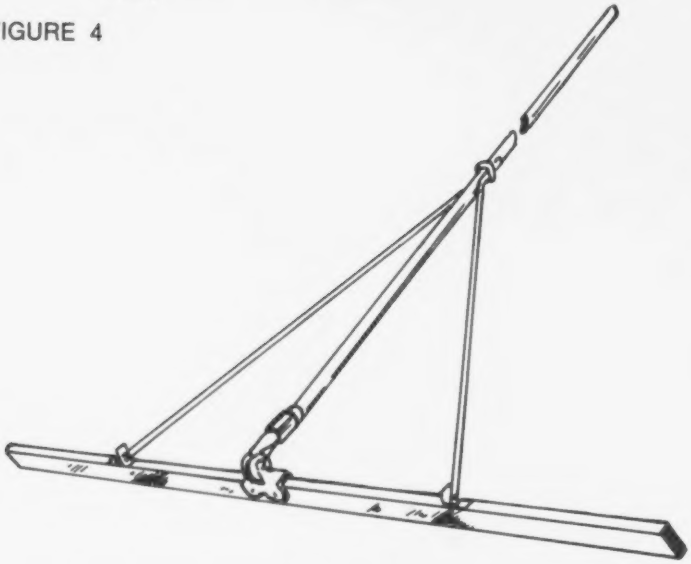


INFORMATION SHEET

2. Paver's (highway) straightedge

   (NOTE: The paver's straightedge has a stationary head and a long handle. It is used to check pavement levelness, to cut off high places, and to fill voids.)

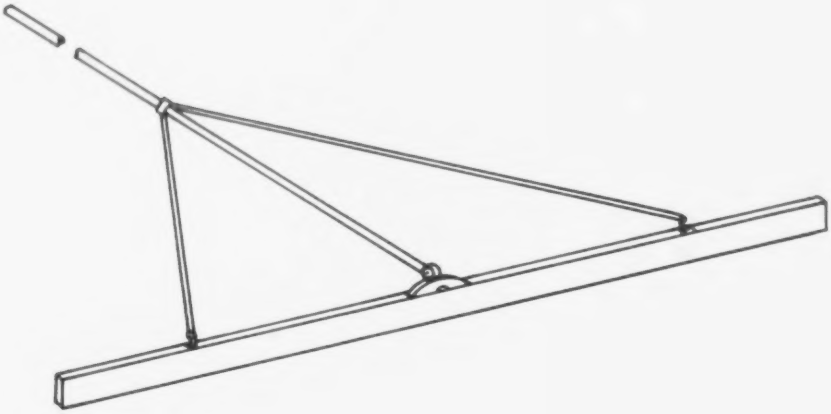
FIGURE 4



3. Long-handled, 12-foot, adjustable-head straightedge

   (NOTE: The long-handled, 12-foot, adjustable-head straightedge is a heavy straightedge used at right angles to the rodding process to strike-off slabs to create super-flat floors.)

FIGURE 5



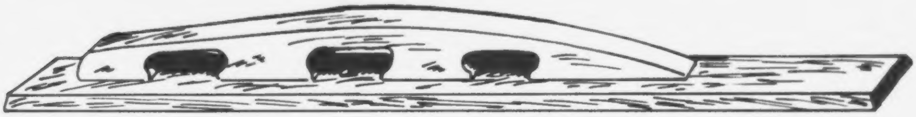
INFORMATION SHEET

B. Types of darbies (Figures 6-8)

(NOTE: Darbies are long, flat rectangular pieces of wood or magnesium that have handles and come in lengths of from 2 1/2 to 6 1/2 feet and widths of from 3 to 4 inches. Magnesium and wood darbies can be used on the same types of jobs [roof slabs, pavement, sidewalks], but magnesium darbies are more durable, prevent drag, and are preferred on some types of topping and on air-entrained concrete.)

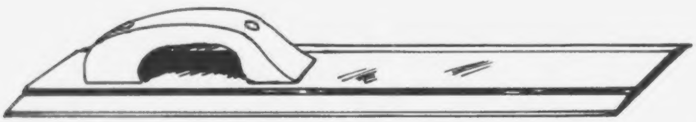
1. Wood darby

FIGURE 6



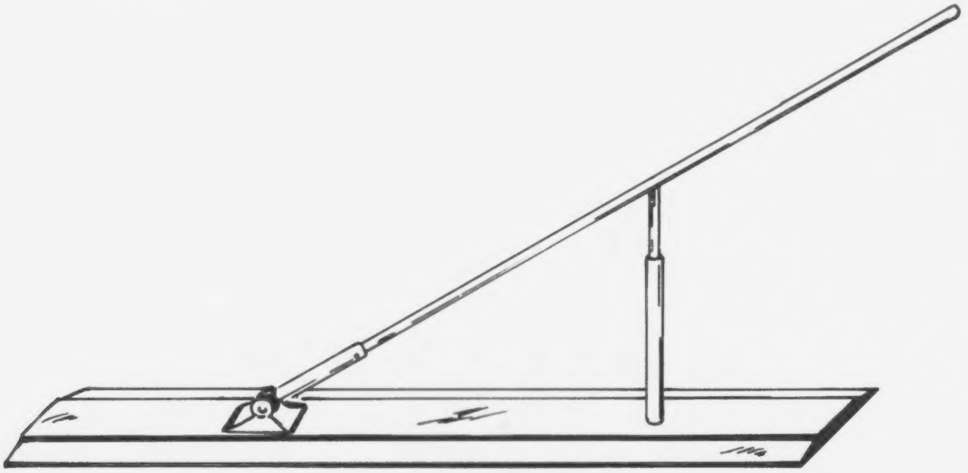
2. Small magnesium darby

FIGURE 7



3. Long-handled magnesium darby

FIGURE 8



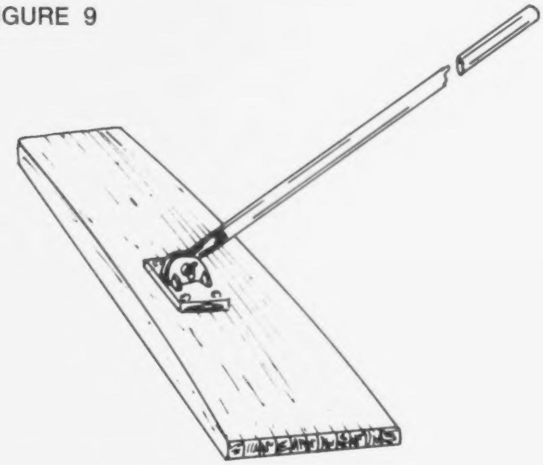
INFORMATION SHEET

C. Types of bull floats (Figures 9 and 10)

(NOTE: Bull floats serve the same general function as darbies, but they are more commonly used in locations where there is enough room to accommodate their 4- to 18-foot handle. The tool itself is a large, flat, rectangular piece of wood or metal [aluminum or magnesium] that is usually 8 inches wide and ranges in length from 3 ½ to 5 feet. Both wood and metal bull floats can be used to bull float floor slabs, pavement, and sidewalks made with normal types of concrete, but metal bull floats prevent drag, are much lighter than wood bull floats, and are preferred on some toppings, low-slump concrete, and air-entrained concrete.)

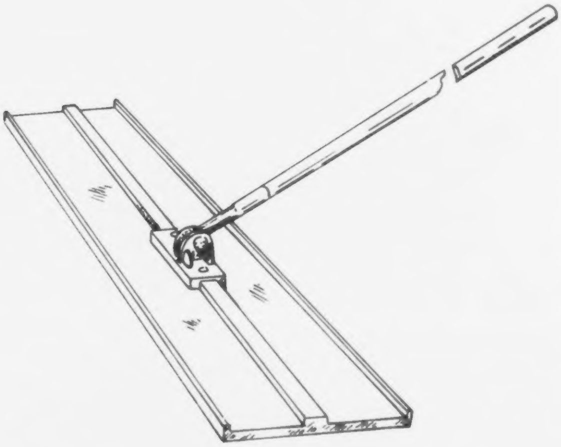
1. Wood bull float

FIGURE 9



2. Metal (magnesium or aluminum) bull float

FIGURE 10



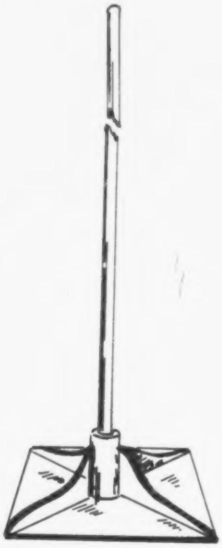
INFORMATION SHEET

D. Types of tampers (tamps) (Figures 11-13)

(NOTE: There are three basic types of tampers: the small, flat, hand-held type; the larger 3- to 4-foot jitterbug; and the largest 3- to 6-foot rollerbug. The size of the job determines the size of the tamper used, but all types are used *only* on low-slump [1 inch or less] concrete.)

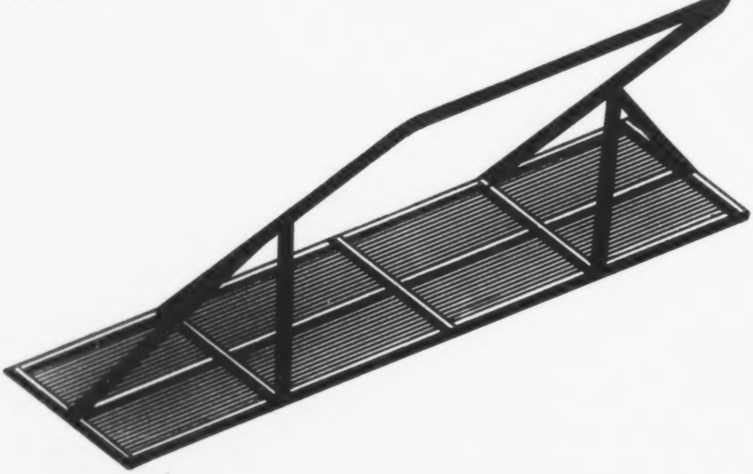
1. Hand tamper

FIGURE 11



2. Jitterbug

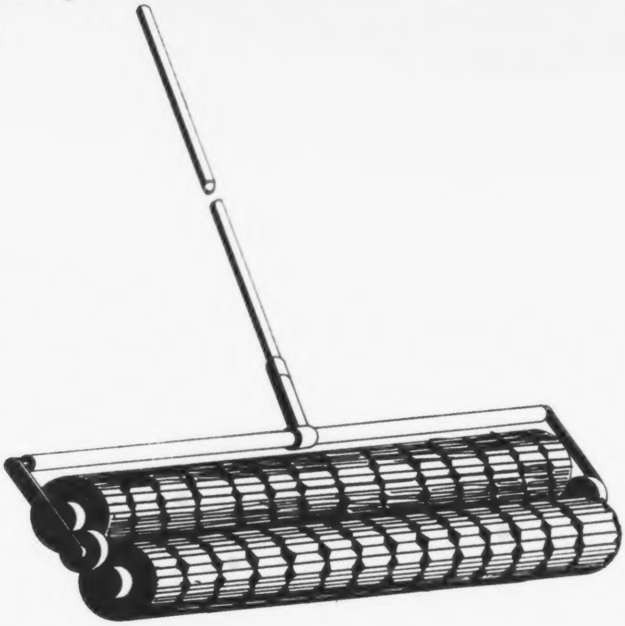
FIGURE 12



INFORMATION SHEET

3. Rollerbug

FIGURE 13

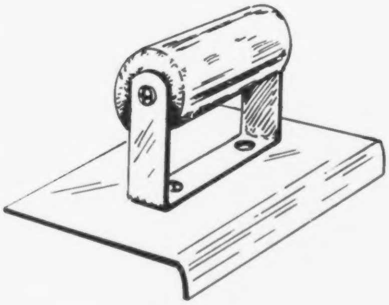


E. Types of edgers (Figures 14-19)

(NOTE: Edgers are made of steel, stainless steel, bronze, or malleable iron. They are available in many sizes, but the most common sizes are those from 6 to 10 inches long, from 1 1/2 to 4 inches wide, and with a lip that is from 1/8 to 5/8 inch and a radius from 1/8 to 1 1/2 inch. Edgers are used to edge sidewalks, floor slabs, driveway approaches, and pavement. Some edgers have a long handle so that they can be used while the mason is standing.)

1. Sidewalk edger

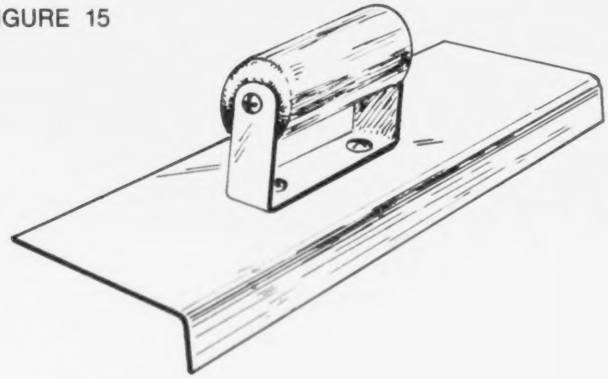
FIGURE 14



INFORMATION SHEET

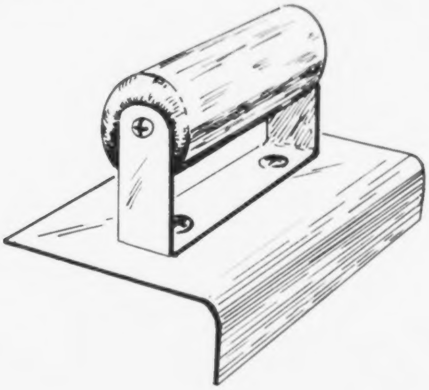
2. Pavement edger

FIGURE 15



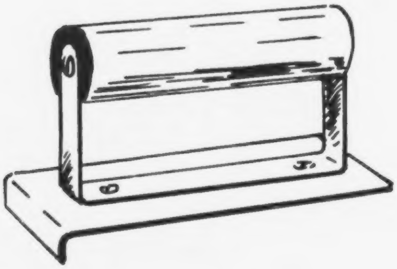
3. Curb edger

FIGURE 16



4. Radius edger

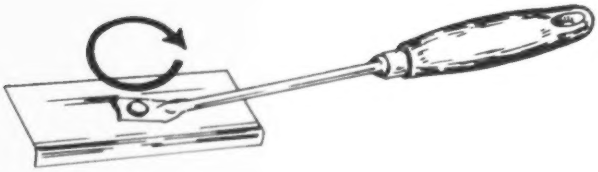
FIGURE 17



INFORMATION SHEET

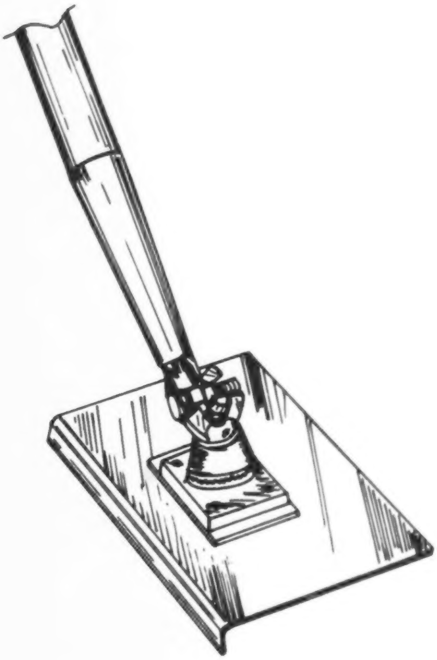
5. Step-and-windowsill edger

FIGURE 18



6. Long-handled walking-type edger

FIGURE 19



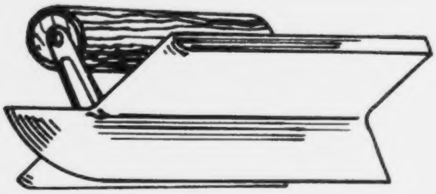
INFORMATION SHEET

F. Types of jointers (groovers) (Figures 20-22)

(NOTE: Jointers are made of stainless steel, bronze, or malleable iron. Common jointers are 6 inches long; vary in width from 2 to 4 $^{1}/_{2}$ inches; and have shallow, medium, or deep bits [cutting edges] ranging from $^{3}/_{16}$ to 1 inch in depth. Some jointers also have a long handle so that they can be used while the mason is standing. Jointers are used to make joints in sidewalks, pavement, patios, and floor slabs.)

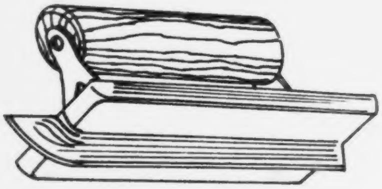
1. Deep-bit hand-type jointer

FIGURE 20



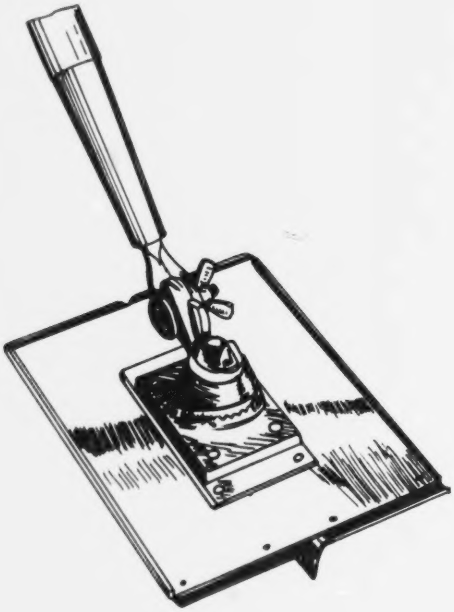
2. Small-bit hand-type jointer

FIGURE 21



3. Long-handled walking-type jointer

FIGURE 22



INFORMATION SHEET

G. Types of hand floats (Figures 23-27)

(NOTE: Common hand floats are made of wood or metal [steel, aluminum, or magnesium]. Metal floats are usually 3 1/2 inches wide, but come in one of two lengths: 12 or 16 inches. Wood floats are available in 12-, 15-, or 18-inch lengths and in 3 1/2- or 4 1/2-inch widths. Both metal and wood hand floats can be used to float normal types of concrete; however, metal floats prevent drag, are lighter than wood floats, and are preferred on some types of toppings and on air-entrained concrete. Special types of hand floats made of cork, rubber/sponge, or carpet are used to create textured finishes on rubbed concrete.)

1. Common wood or metal float

FIGURE 23: Wood float

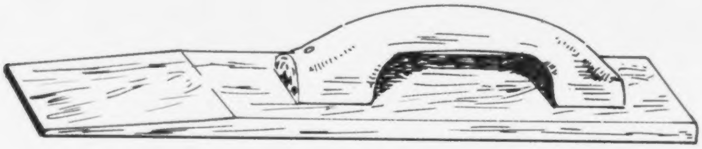
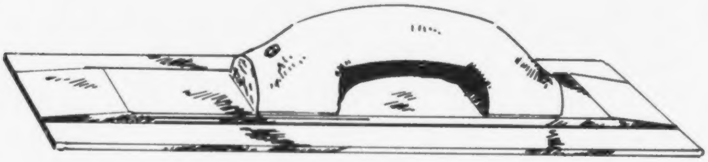
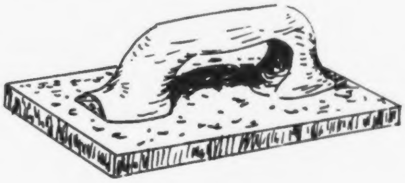


FIGURE 24: Magnesium float



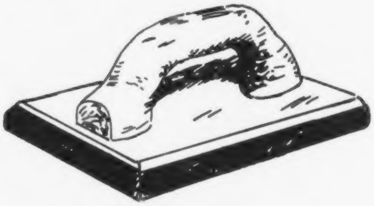
2. Special cork float

FIGURE 25



3. Special rubber/sponge float

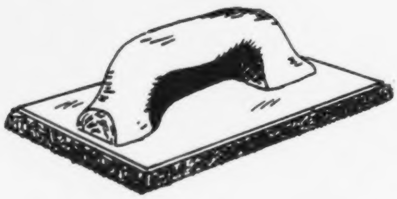
FIGURE 26



INFORMATION SHEET

4. Special carpet float

FIGURE 27

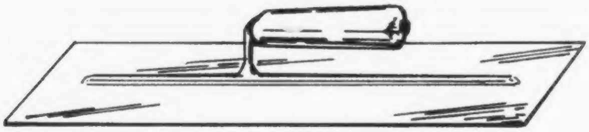


H. Types of trowels (Figures 28-31)

(NOTE: Hand trowels are made from either high-carbon tempered steel or special long-wearing stainless steel, and they come in a variety of sizes ranging from 10 to 20 inches long and from 3 to 5 inches wide. The size chosen depends on the job to be done. For example, a wide trowel [16 to 20 inches] is usually used for the first troweling process, while a smaller trowel [14 to 16 inches] is used for the final troweling. Also, fresno trowels fitted with long handles are used when the mason must stand to trowel the concrete surface.)

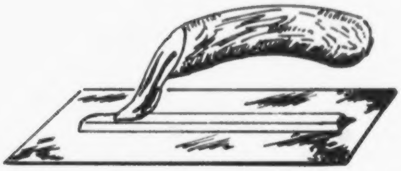
1. Finishing trowel

FIGURE 28



2. Midget trowel

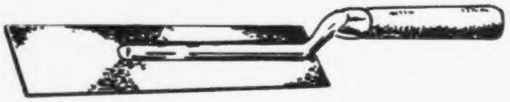
FIGURE 29



INFORMATION SHEET

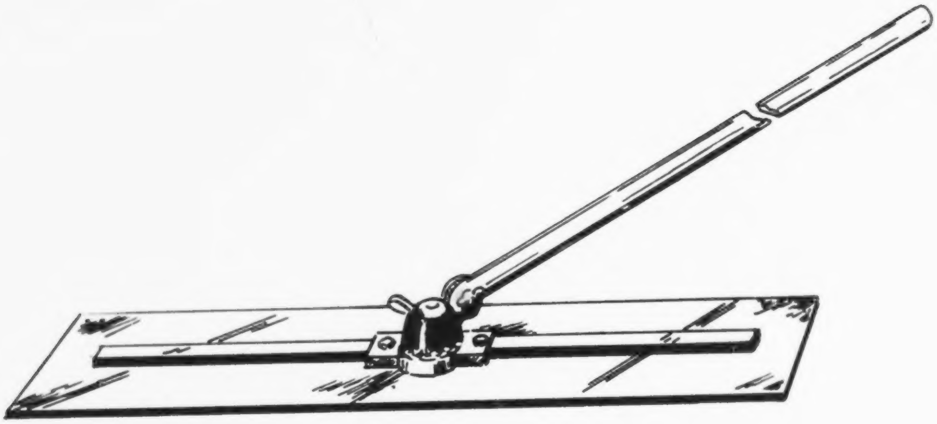
3. Pipe trowel

FIGURE 30



4. Fresno trowel

FIGURE 31



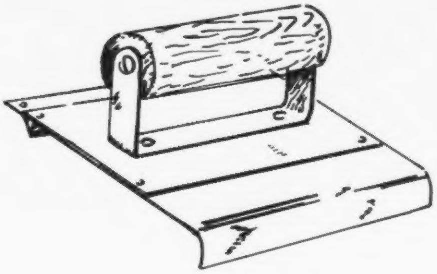
INFORMATION SHEET

I. Types of combination tools (Figures 32-36)

(NOTE: Combination tools are tools designed to do the special jobs their names suggest: edge and joint, curb and gutter, etc. In the past, these tools were made of metal, but some are now being made from new plastics that have been developed.)

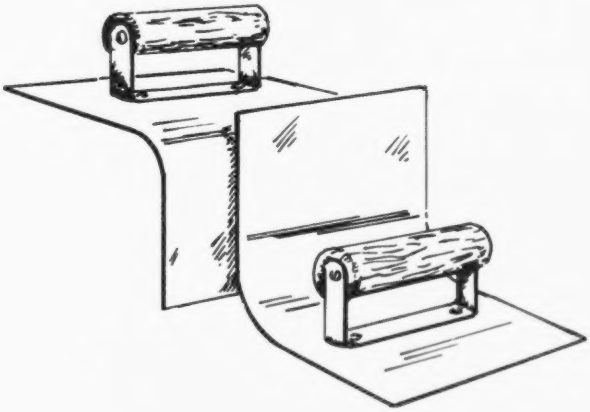
1. Edger/jointer

FIGURE 32



2. Curb-and-gutter tool

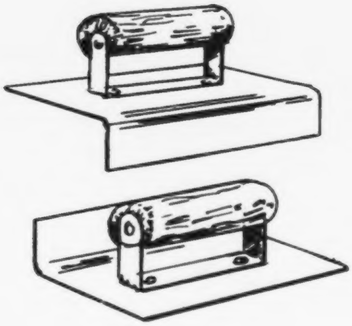
FIGURE 33



INFORMATION SHEET

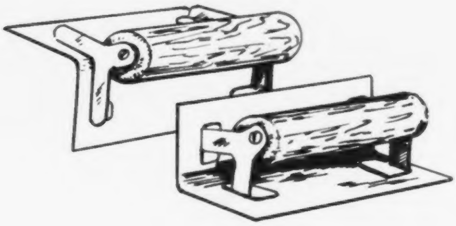
3. Step-and-sidewalk tool

FIGURE 34



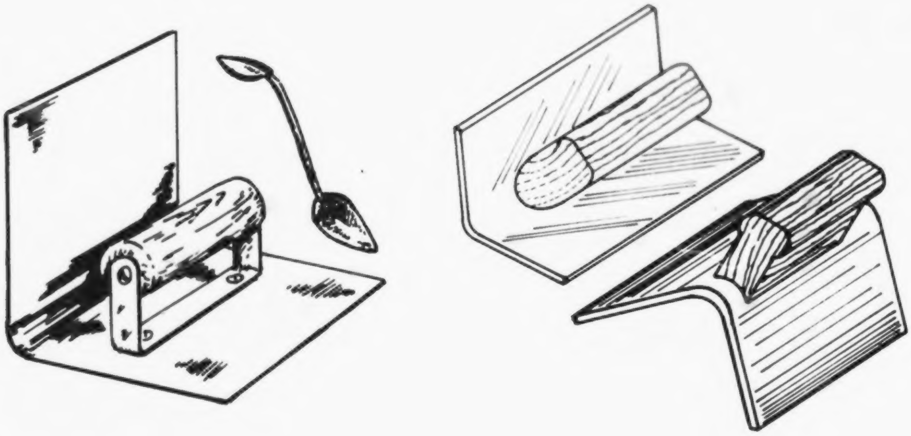
4. Step-and-corner tool

FIGURE 35



5. Cove-and-base tool

FIGURE 36



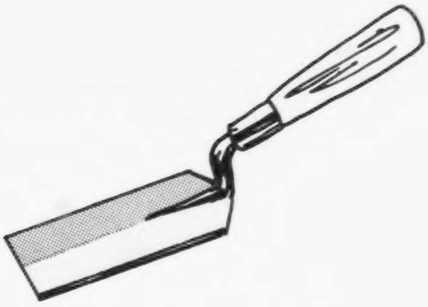
INFORMATION SHEET

V. Hand tools used for patching and mixing concrete (Figures 37 and 38)

A. Margin trowel

(NOTE: The margin trowel is used primarily to mix mud, patch holes, and grout machine bases; however, it can also be used to finish patches and small, difficult-to-reach areas.)

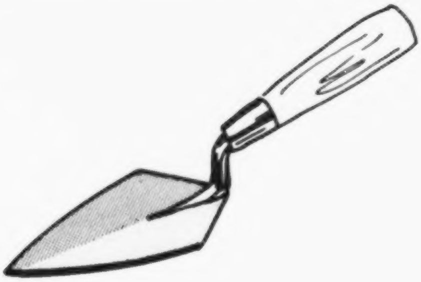
FIGURE 37



B. Pointing trowel

(NOTE: The pointing trowel is the tool most commonly used by masons. It is used to patch holes, to grout machine bases, and to clean other tools such as bull floats, trowel-machine blades, and knee boards.)

FIGURE 38



VI. Hand tools used for working with hardened concrete

A. Types of concrete hammers (Figures 39-41)

(NOTE: There are two types of hammers used by masons to work with hardened concrete: the chipping hammer and the bush hammer. Chipping hammers are used to cut off projections and high places on hardened concrete, and bush hammers are used to cut off humps on hardened concrete and to fracture aggregate to present a rough, colorful finish.)

INFORMATION SHEET

1. Chipping hammer

FIGURE 39

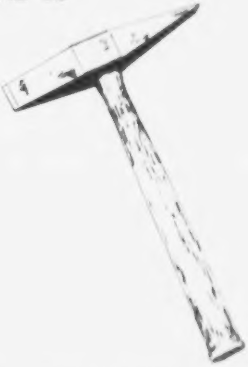
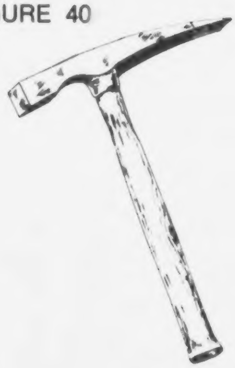
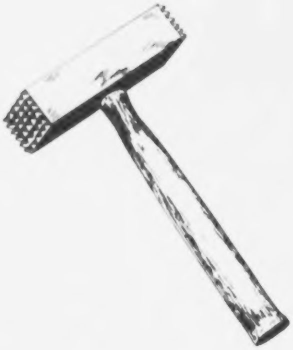


FIGURE 40



2. Bush hammer

FIGURE 41

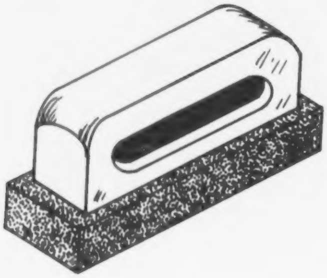


B. Types of Carborundum rubbing stones (Figures 42-44)

(NOTE: Rubbing stones are tools used for dressing down hardened concrete. Common rubbing stones are 6 to 8 inches long, 2 to 3 1/2 inches wide, and 3/4 to 2 inches thick. Grit sizes range from #24 [coarse] to #150 [fine].)

1. Small, 6"-x-2"-x-1" rubbing stone

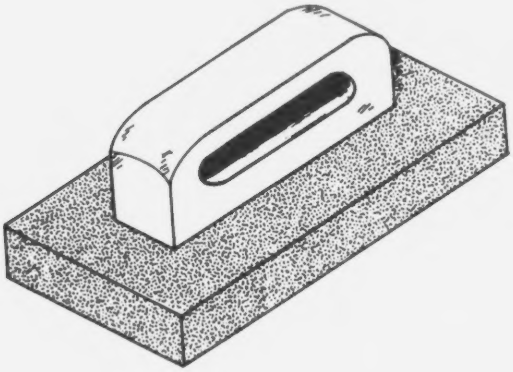
FIGURE 42



INFORMATION SHEET

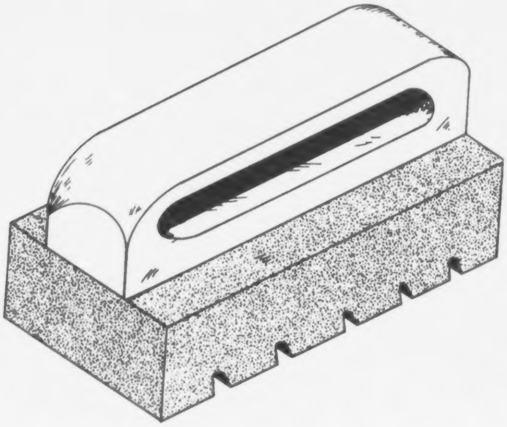
2. Medium-sized, 8"-x-3 1/2"-x 3/4" rubbing stone

FIGURE 43



3. Large-sized, fluted, 8"-x-3 1/2"-x-1 1/2" rubbing stone

FIGURE 44

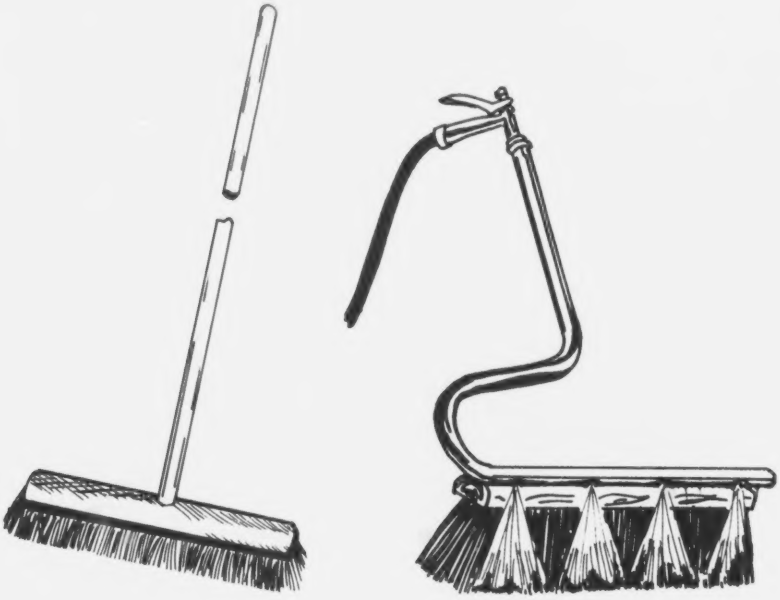


VII. Miscellaneous hand tools and equipment

A. Finishing broom (Figure 45)

(NOTE: Finishing brooms are used to finish fresh concrete and to clean hardened concrete.)

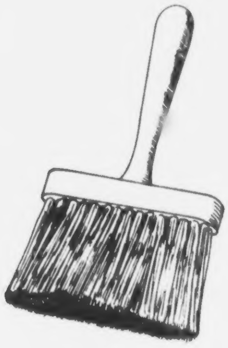
FIGURE 45



B. Brush (Figure 46)

(NOTE: Brushes are used in finishing and rubbing operations and to clean other tools.)

FIGURE 46



INFORMATION SHEET

C. Chisel (Figures 47-49)

(NOTE: Chisels of various sizes and shapes are used to cut off projections and to chip off loose or scaled concrete.)

FIGURE 47

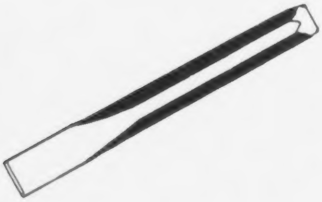


FIGURE 48

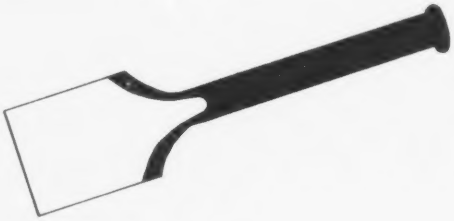
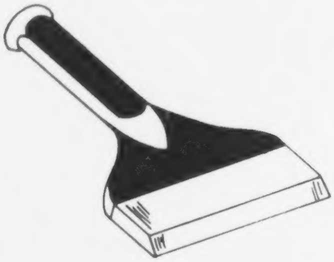


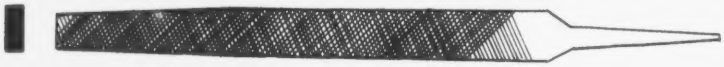
FIGURE 49



D. Flat file (Figure 50)

(NOTE: Flat files are used to dress edges of trowels and to file off burrs on other tools.)

FIGURE 50



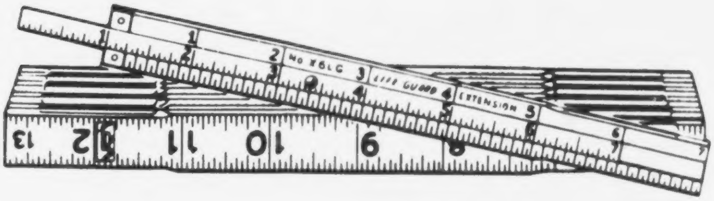
INFORMATION SHEET

E. Measuring tools (Figures 51-53)

(NOTE: Folding rules and steel tapes are used to measure areas to be concreted, to measure lumber, and to lay out work.)

1. Folding rule

FIGURE 51



2. Steel tape

FIGURE 52: 6-foot tape

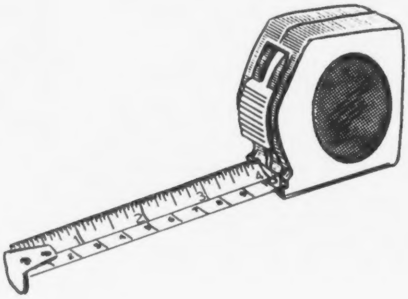
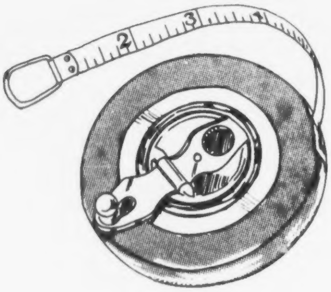


FIGURE 53: 100-foot tape



HAND TOOLS
UNIT II

JOB SHEET #1 — USE A BULL FLOAT

I. Tools and equipment

  A. Bull float

  B. Concrete or sand pad

  C. Protective clothing

II. Procedure

  (NOTE: Bull floating is done immediately after the concrete has been straightedged. When possible, bull float in a direction that is perpendicular to the direction of the straightedging process.)

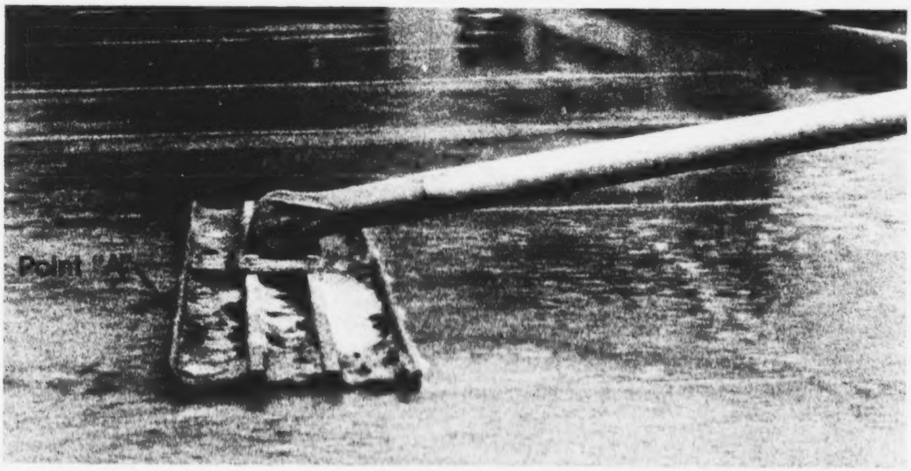
  A. Adjust bull-float handle to your reach (so that the bull float will be comfortable for you to use)

  B. Make first pass

    1. Set bull-float blade on edge of concrete

    2. Position bull-float handle low enough so that leading edge of blade (Point A) is raised slightly (Figure 54)

FIGURE 54



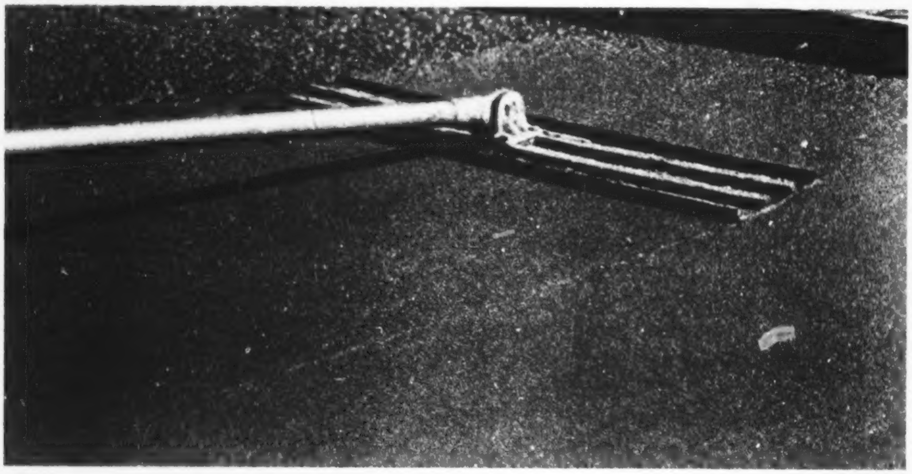
    3. Begin forward stroke by pushing and sliding bull float across slab while keeping handle low enough to maintain slightly raised leading edge of blade

JOB SHEET #1

4. As you near end of forward stroke, jiggle bull float slightly while raising bull-float handle to flatten blade against concrete surface (Figure 55)

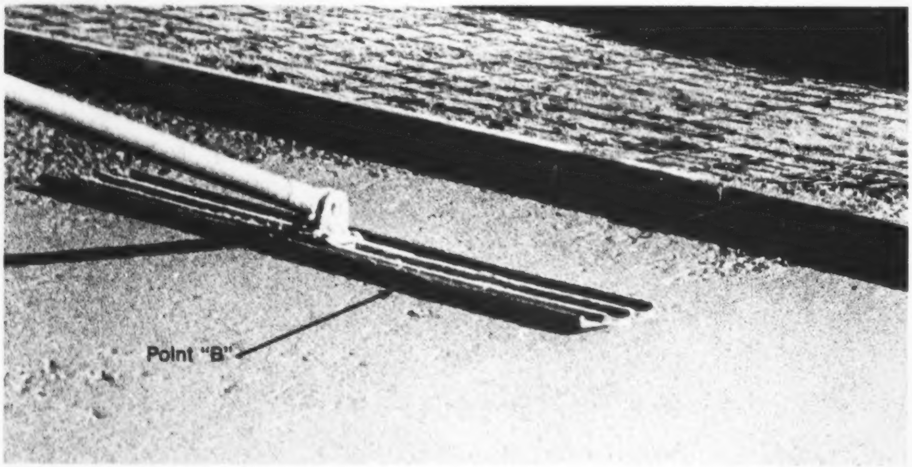
   (NOTE: This procedure helps break the vacuum under the blade and prevents dishing of the concrete surface.)

FIGURE 55



5. When you reach end of forward stroke, raise handle slightly and without hesitating start return stroke, keeping leading edge of blade (Point B) raised *very* slightly (almost flat) to concrete surface (Figure 56)

FIGURE 56



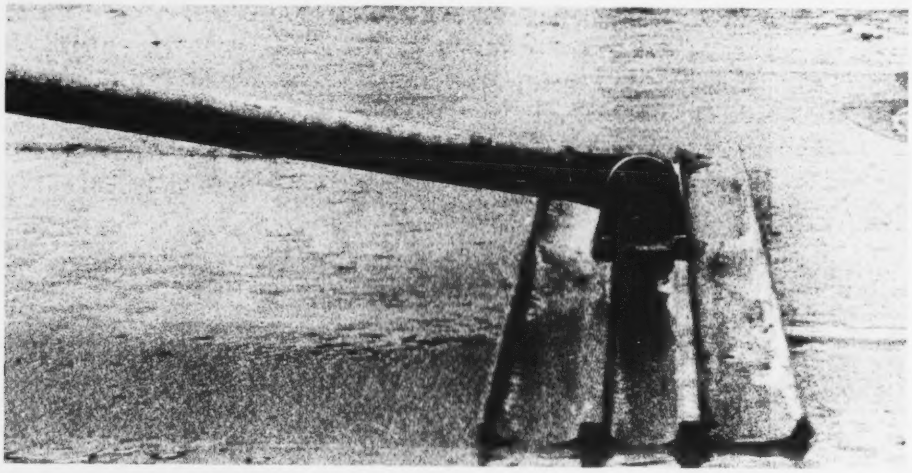
JOB SHEET #1

6. If necessary, make another forward stroke, keeping blade as flat as possible while preventing blade edges from digging into concrete surface

C. Make second pass

1. Place bull float so that blade will overlap first pass by at least 6 inches (Figure 57)

FIGURE 57



2. Repeat procedures in Step B, 2 through 6

D. Continue until slab has been completely bull floated, overlapping passes by at least 6 inches and following procedures in Step B, 2 through 6

(NOTE: To improve levelness of slab, it is sometimes necessary to bull float crosswise to first bull-floating process. If this is necessary, follow Steps A through D to complete second bull-floating process.)

E. Clean work area and tools, and properly store tools and equipment

HAND TOOLS
UNIT II

JOB SHEET #2 — USE A HAND FLOAT AND A FINISHING TROWEL

I. Tools and equipment

   A. Hand float

   B. Large finishing trowel

   C. Kneepads

   D. Concrete or sand pad

   E. Protective clothing

II. Procedure

(NOTE: Through experience, you will eventually know when it is appropriate to begin the floating process. However, for now, check with your instructor before performing this job sheet.)

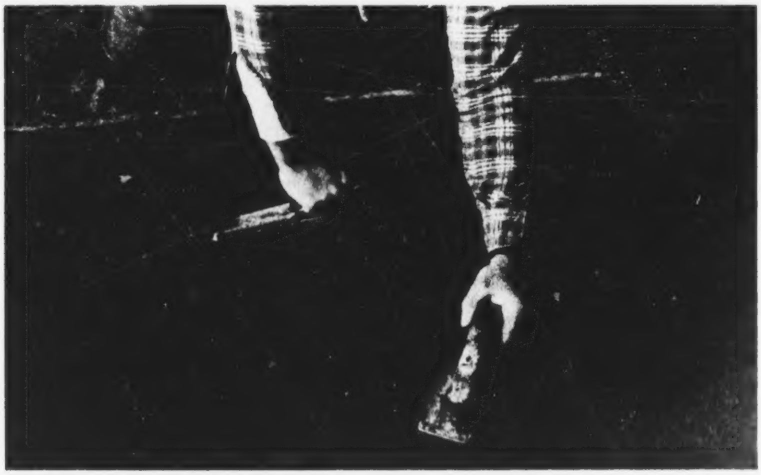
   A. While holding hand float in dominant hand and trowel in the other hand, position yourself on your knees near edge of forms

   (NOTE: Your dominant hand is the hand you use most effectively.)

   B. Lean out over edge of concrete, supporting yourself on trowel (Figure 58)

   (NOTE: This position allows you to reach further out.)

FIGURE 58



   C. Make first pass with hand float

JOB SHEET #2

1. Hold float flat on concrete surface (See Figure 59)
2. Move float in a wide, semicircular motion (Figure 59)

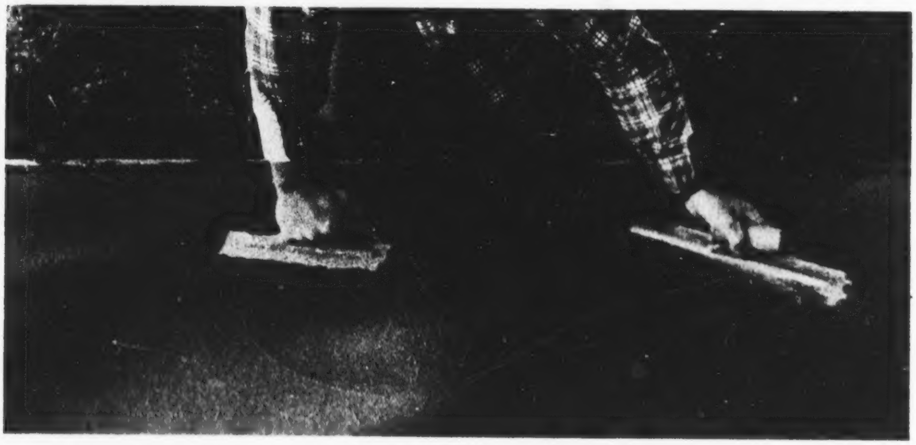
FIGURE 59

3. Level high spots or imperfections by using a forward-and-backward sawing motion of the float

D. Maintain position and make second pass with hand float

1. Move float back (toward you), while overlapping first pass (Figure 60)

FIGURE 60



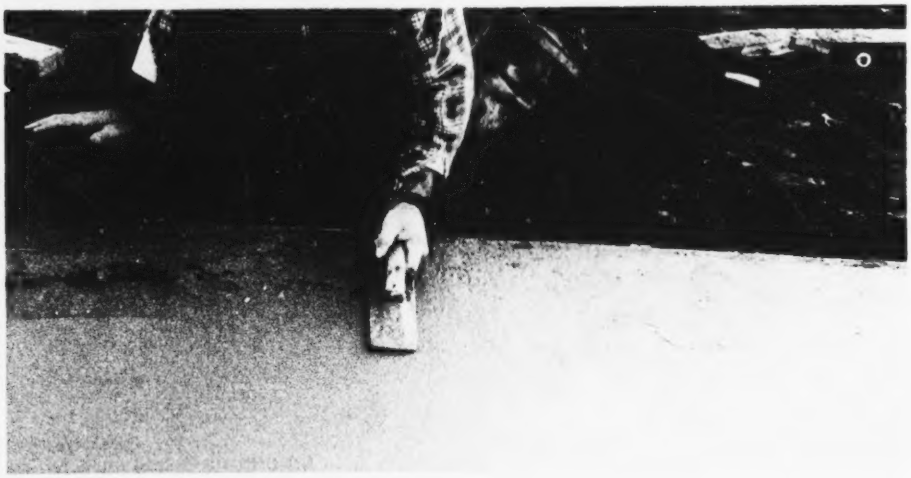
JOB SHEET #2

   2. Follow procedures in Step C for completing pass

E. Maintain position and continue floating, following procedures in Steps C and D, until all of area you can reach has been floated except area along form edge

F. Reposition yourself and float area along edge of forms, moving float at a right angle to form (Figure 61)

FIGURE 61



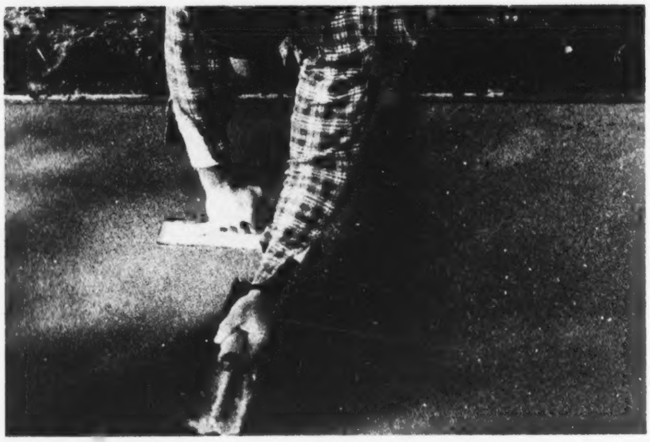
G. Reposition yourself as in Steps A and B, but place trowel in dominant hand and float or trowel in the other hand (See Figure 62)

H. Make first trowel pass

   1. Hold trowel flat on concrete surface

   2. Move trowel in a wide, semicircular motion (Figure 62)

FIGURE 62

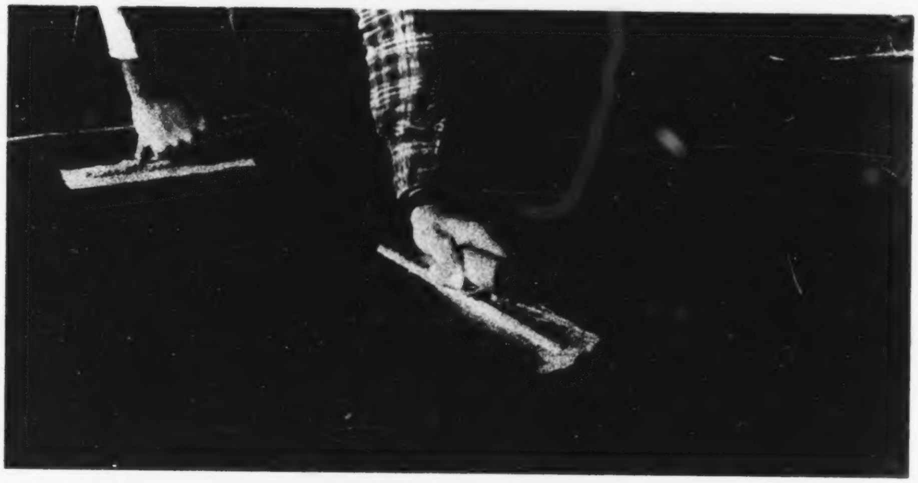


JOB SHEET #2

I. Maintain position and make second pass with trowel

1. Move trowel back (toward you), while overlapping first pass (Figure 63)

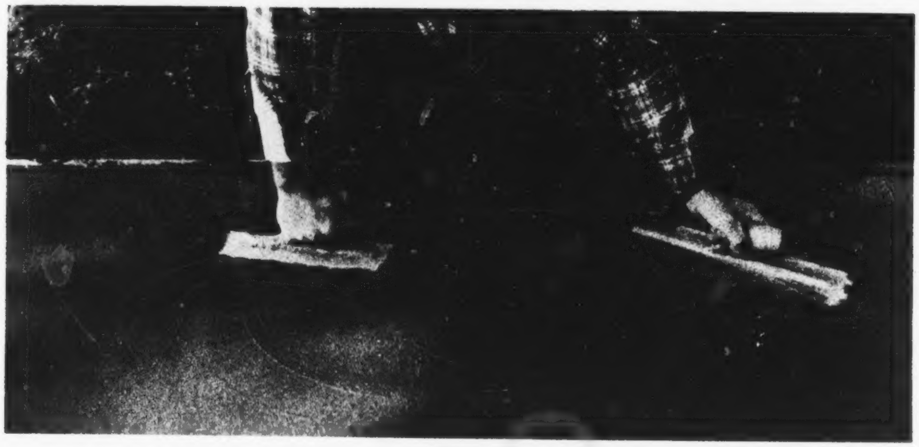
FIGURE 63



2. Follow procedures in Step H for completing pass

J. Maintain position and continue troweling, following procedures in Steps H and I, until all of area you can reach has been troweled except area along form edge (Figure 64)

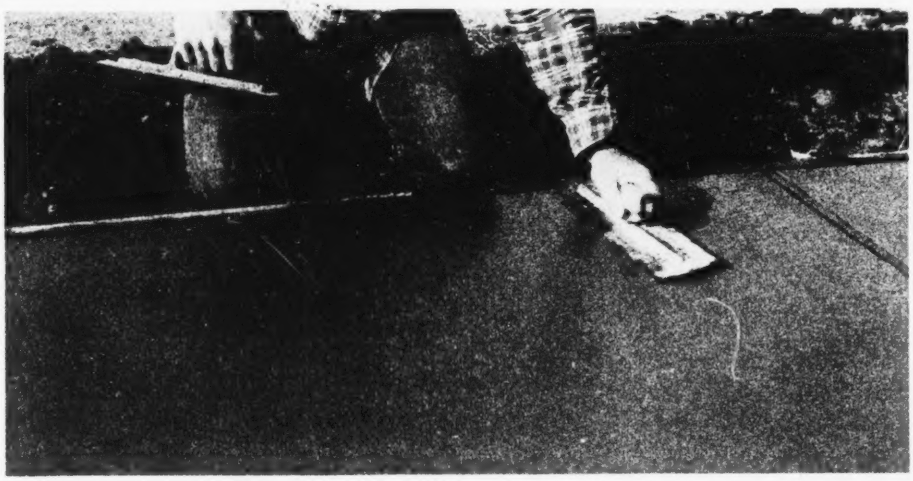
FIGURE 64



JOB SHEET #2

K. Reposition yourself as in Step F, and trowel area along edge of forms, moving trowel at right angle to form (Figure 65)

FIGURE 65



L. Continue positioning yourself along form edge and following Steps A through K to float and trowel until all edges have been floated and troweled

(NOTE: As concrete hardens and moisture evaporates, the concrete may have to be troweled another time or two [sometimes even more]. On each successive troweling, you should use a smaller trowel and tilt the blade a little more. You will find that as the concrete hardens you will need to increase the pressure placed on the trowel in order to remove imperfections as you trowel.)

M. Clean work area and tools, and properly store tools and equipment

HAND TOOLS
UNIT II

JOB SHEET #3 — USE AN EDGER

I. Tools and equipment

   A. Margin trowel

   B. Edger

   C. Kneepads

   D. Concrete pad

   E. Protective clothing

II. Procedure

   A. Float and trowel slab edges (See Job Sheet #2)

   B. Position yourself on your knees near edge of forms

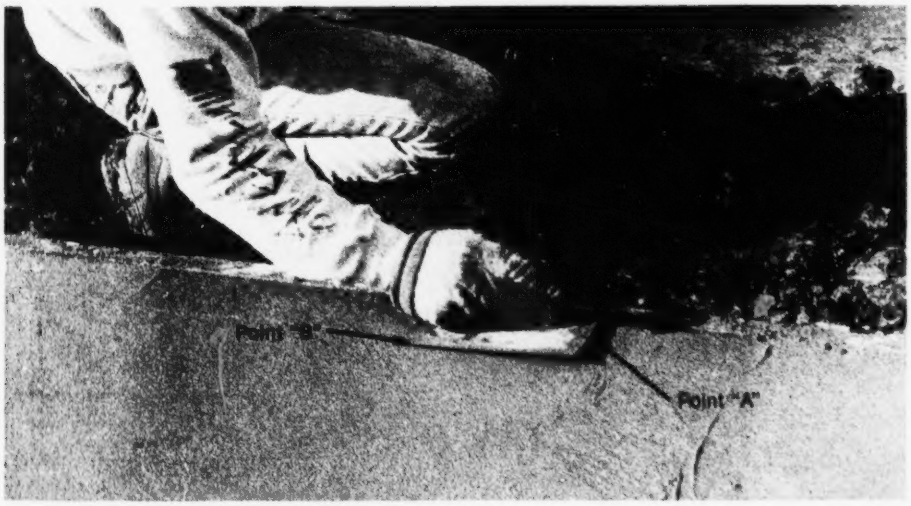
   C. Make arm's length pass with margin trowel to cut along inside of form

   (NOTE: Making a pass with a margin trowel helps to force the aggregate away from the form and makes it easier to use the edger.)

   D. Make arm's length pass with edger

      1. Hold edger with leading edge (Point A) raised just enough to keep edger from digging into concrete and with rear edge (Point B) pressed down lightly (Figure 66)

FIGURE 66

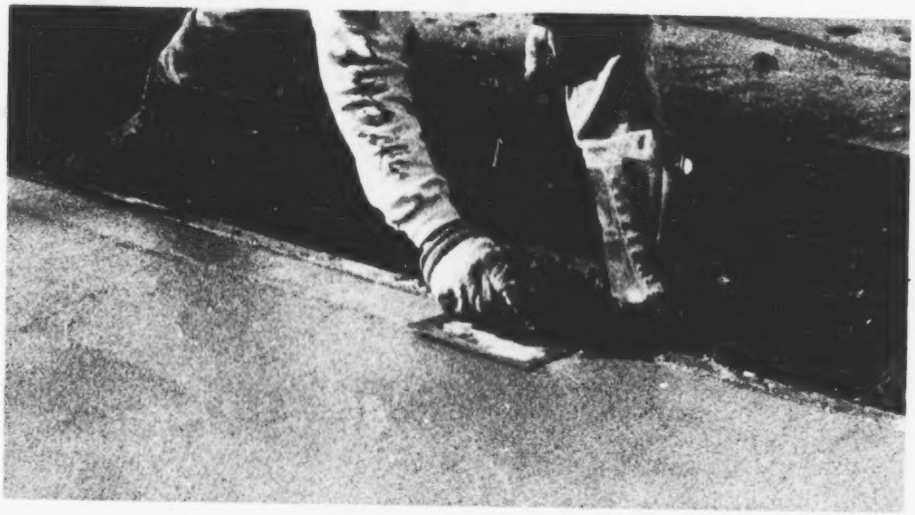


JOB SHEET #3

2. Begin forward stroke by gliding edger across top of concrete until your arm is nearly fully extended (Figure 67)

   (NOTE: *Do not* press too hard on the edger; the edger should make hardly any indentation on the top surface of the concrete.)

FIGURE 67

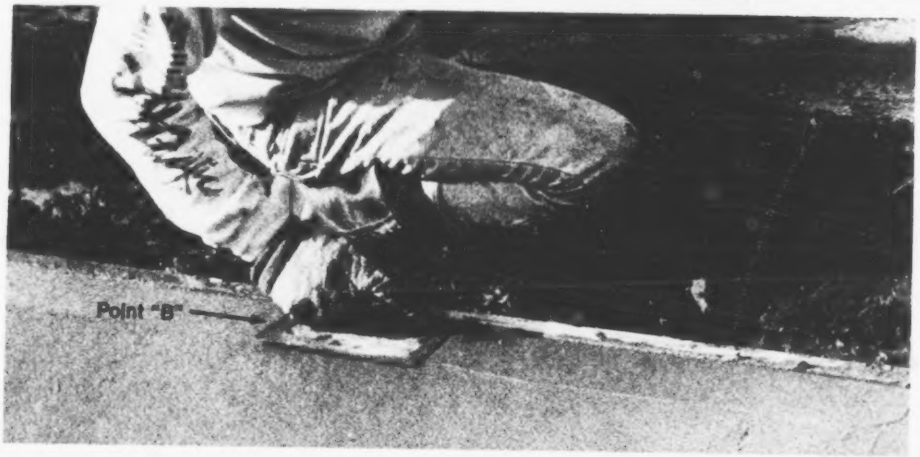


3. At end of forward stroke (when arm is fully extended), lift edger from concrete while edger is still in forward motion

   (NOTE: If the edger is not in motion when it is removed from the concrete, the concrete surface may be pulled up with the edger.)

4. With arm still extended, begin return stroke, drawing edger backward (toward you) with leading edge (Point B) tilted up slightly (Figure 68)

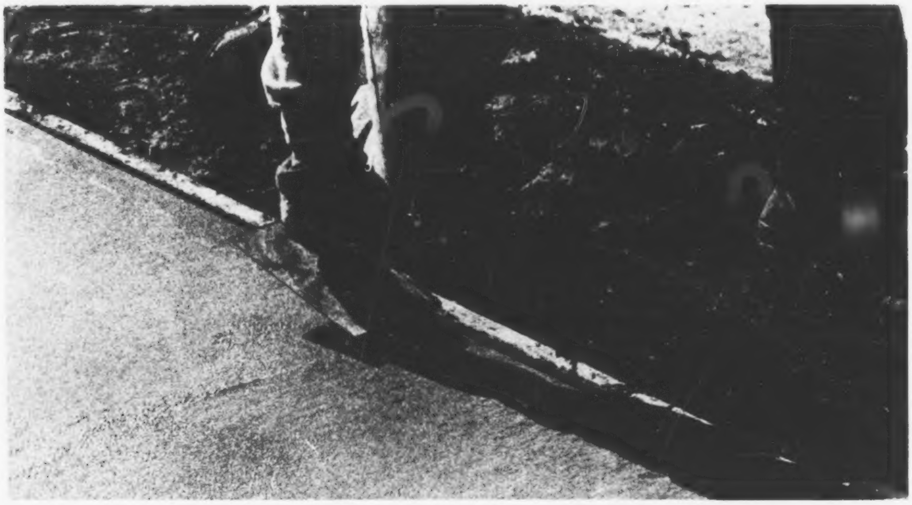
FIGURE 68



JOB SHEET #3

5. At end of return stroke, lift edger from concrete surface while edger is still in motion (Figure 69)

FIGURE 69



E. Continue repositioning yourself and edging, following the procedures in Steps C and D, until slab has been completely edged

F. Clean work area and tools, and properly store tools and equipment

HAND TOOLS
UNIT II

JOB SHEET #4 — DRESS EDGES OF A FINISHING TROWEL

I. Tools and equipment

A. Finishing trowel

B. 12- or 14-inch flat mill file

C. Goggles

D. Leather gloves

E. Knee board or other board with a cleat attached across it (See Figure 70)

F. Flat, solid work surface

(NOTE: Preferably, front end of the board should butt against solid surface, but this is not essential.)

II. Procedure

CAUTION

Handle the trowel carefully. The edges of a trowel are sharp.

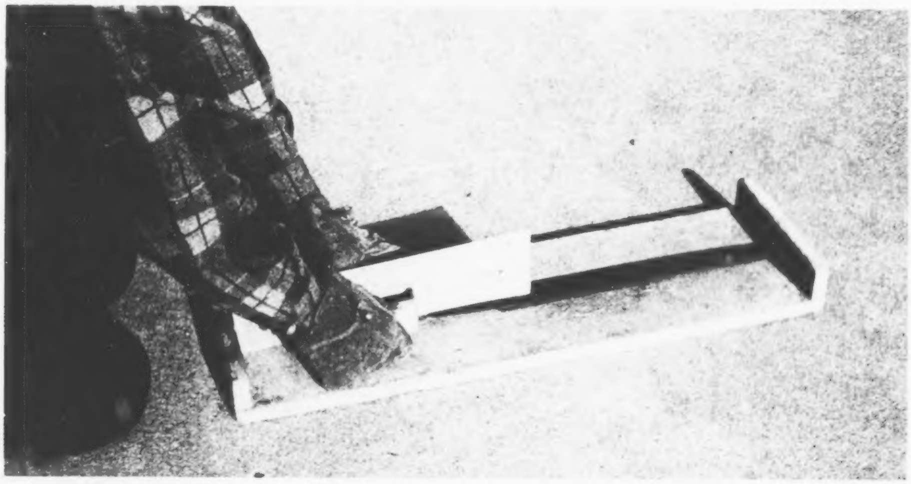
A. Examine file to be sure it is in good condition; discard and replace file if necessary

B. Put on goggles and gloves

C. Place knee board on flat, solid work surface; lay flat side of file on knee board with blunt end of file against cleat on one end of knee board (See Figure 70)

D. Holding trowel handle in dominant hand and using the other hand to hold bottom of blade steady, place trowel edge on end of file with trowel edge perpendicular to file surface (Figure 70)

FIGURE 70



JOB SHEET #4

E. Applying downward pressure and keeping trowel edge perpendicular to file surface, push trowel forward along length of file (Figures 71 and 72)

(NOTE: Keep the blade of the trowel perpendicular to the file so that the trowel edges will be filed square.)

FIGURE 71

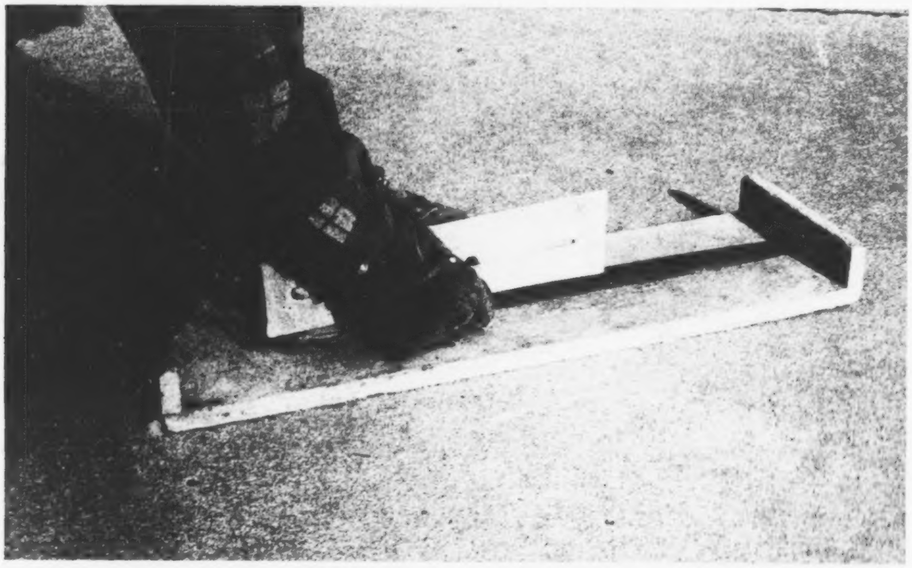
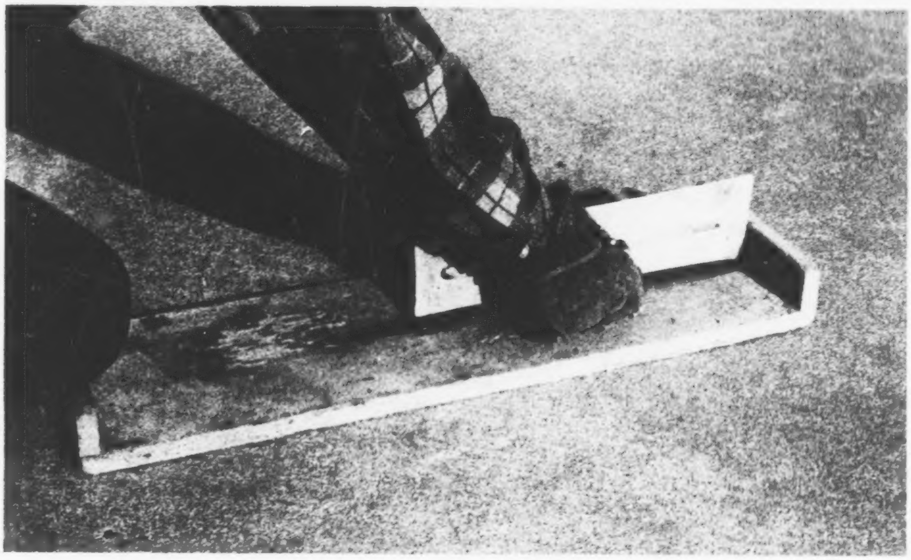


FIGURE 72

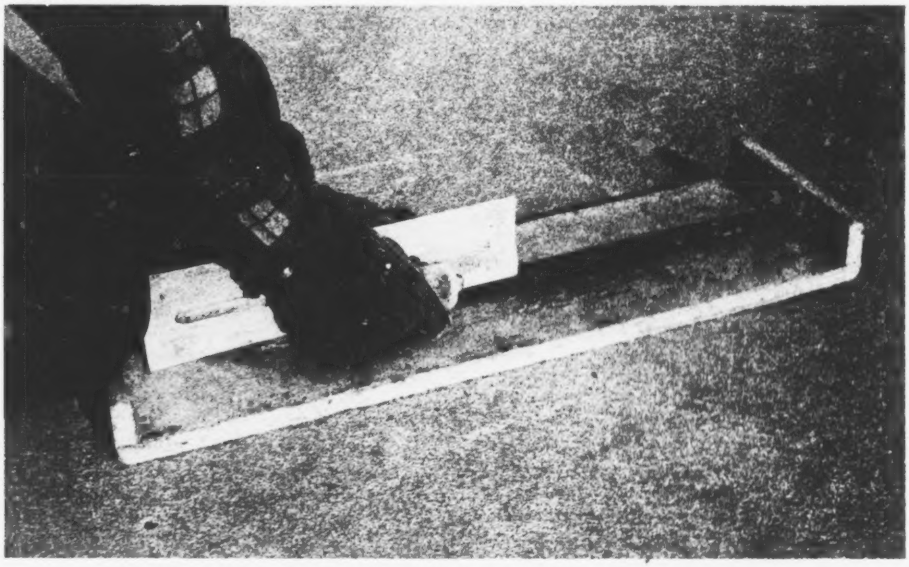


JOB SHEET #4

F. Continue procedures in Steps D and E until trowel edge is straight and square and has no burrs or ragged edges

G. Turn trowel over and follow procedures in Steps D through F to dress other trowel edge (Figure 73)

FIGURE 73



H. Remove goggles and have instructor check work

I. Clean work area and tools, and properly store tools and equipment

HAND TOOLS
UNIT II

TEST

NAME ______________________________ SCORE ______________

1. Match terms and definitions associated with hand tools. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

______a.	To finish fresh-concrete surface by use of a float; precedes troweling when that is to be final finish	1. Place 2. Rod 3. Float
______b.	Process of filling form-tie holes, honeycombs, or any other defects in concrete	1. Patching 2. Finishing 3. Placing
______c.	Concave or radius at bottom section of curb, step, or base	1. Rod 2. Void 3. Cove
______d.	Process of working concrete to desired texture	1. Placing 2. Finishing 3. Patching
______e.	Process of distributing concrete	1. Placing 2. Finishing 3. Honeycombing
______f.	Concrete with a stiff consistency	1. High-slump concrete 2. Low-slump concrete 3. Slow concrete
______g.	Bottom section of a wall	1. Base 2. Rod 3. Cove
______h.	To level concrete to a specific grade	1. Rod 2. Place 3. Finish

TEST

_____i. Empty space, gap

1. Rod
2. Float
3. Void

_____j. Void or cavity left in concrete due to ineffective consolidation

1. Void
2. Rod
3. Honeycomb

---

2. State five guidelines for care and safe use of hand tools.

a. ______________________________

____

b. ______________________________

____

c. ______________________________

____

d. ______________________________

____

e. ______________________________

____

3. State specific uses of hand tools used for placing and finishing fresh concrete.

a. Shovels — ______________________________

____

b. Straightedges — ______________________________

____

c. Darbies______________________________

____

d. Bull floats — ______________________________

____

e. Tampers (tamps) — ______________________________

____

TEST

f. Edgers — ____

____

g. Jointers (groovers) — ____

____

h. Hand floats — ____

____

i. Trowels — ____

____

j. Combination tools — ____

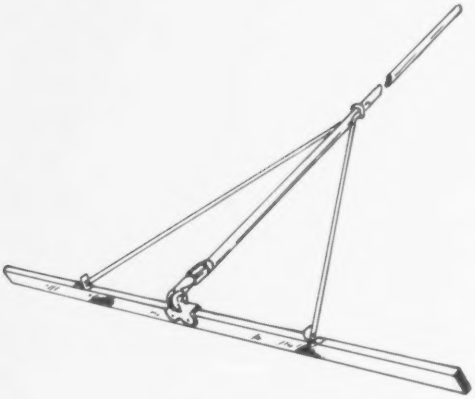
____

4. Identify the following hand tools used for placing and finishing fresh concrete. Write the correct names in the blanks.

Types of straightedges

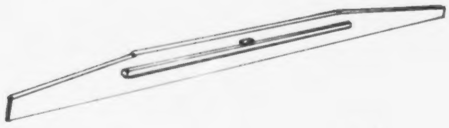
Common wood or magnesium straightedge	Paver's (highway) straightedge

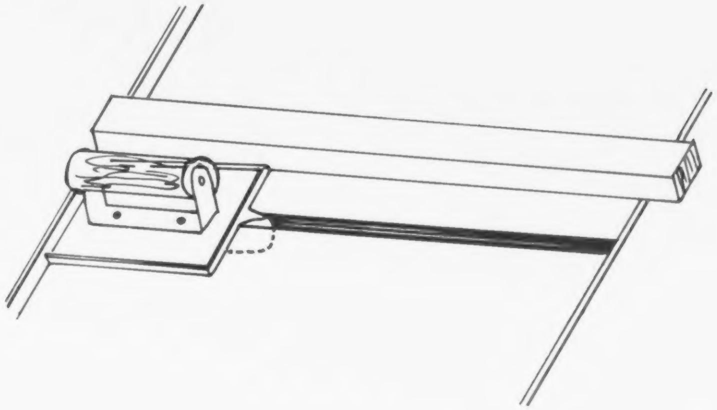
Long-handled,12-foot, adjustable-head straightedge



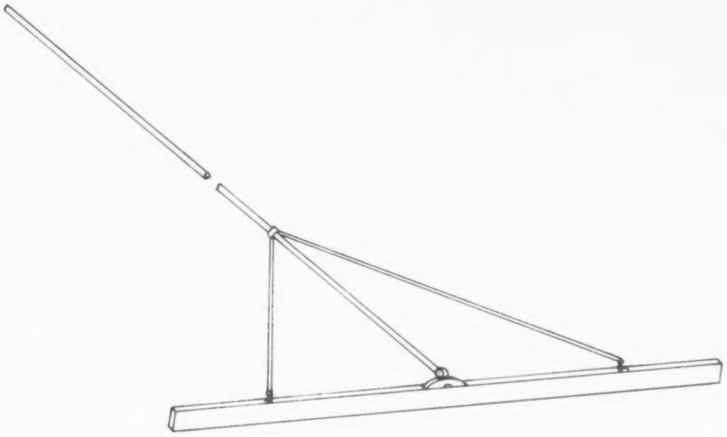
a. ____

TEST





b. ____



c. ____

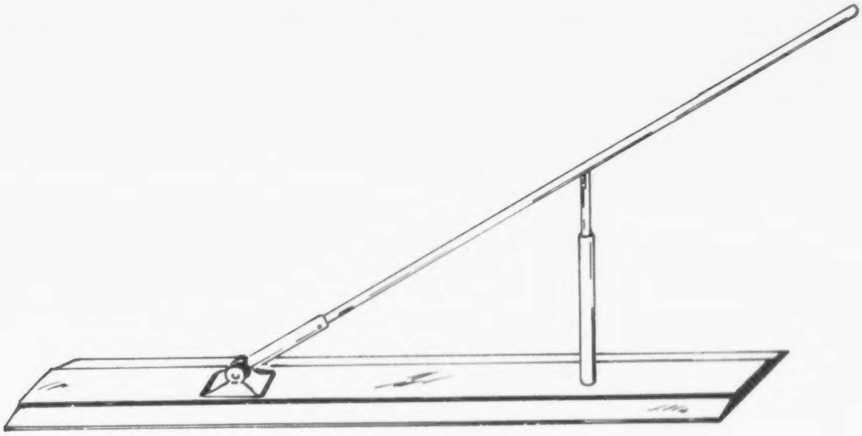
TEST

Types of darbies

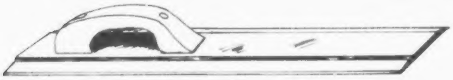
Wood darby

Small magnesium darby

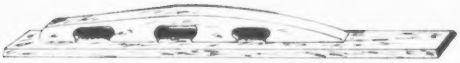
Long-handled magnesium darby



a. ______________________________



b. ______________________________



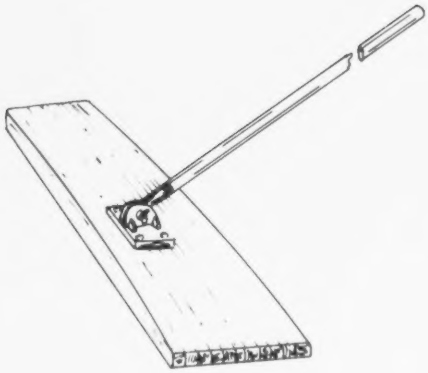
c. ______________________________

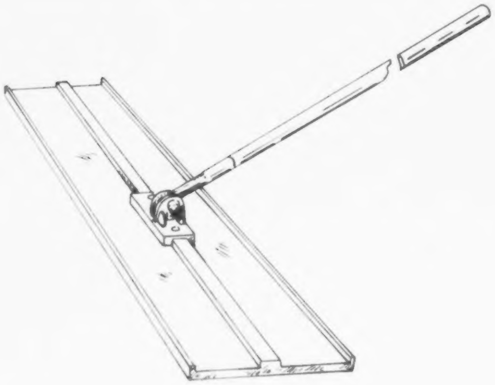
TEST

Types of bull floats

Wood bull float

Metal (magnesium or aluminum) bull float





a. ______________________________

____

b. ______________________________

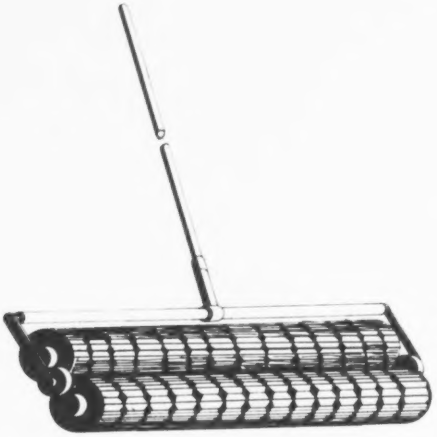
____

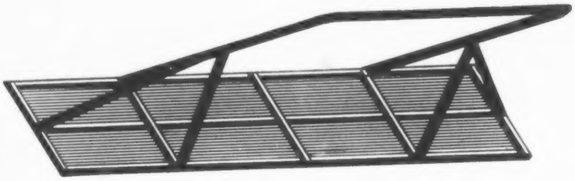
Types of tampers (tamps)

Hand tamper

Jitterbug

Rollerbug

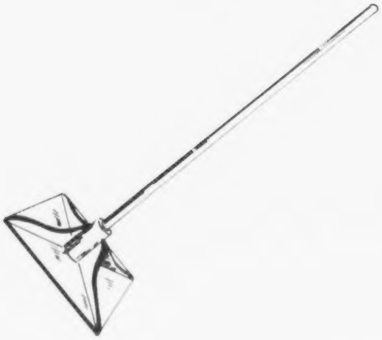




a. ______________________________

b. ______________________________

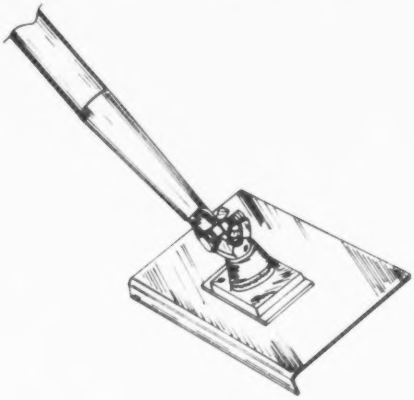
TEST

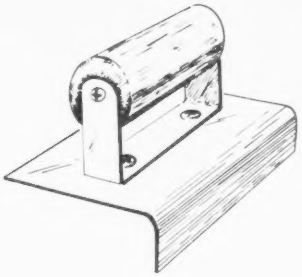


c. ____________________

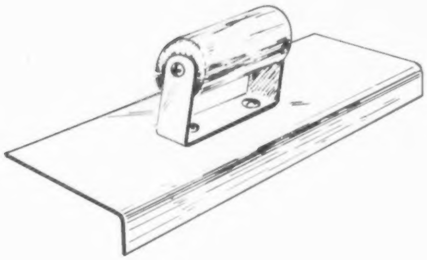
Types of edgers

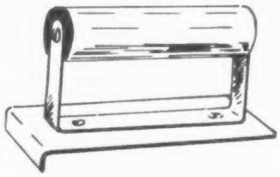
Sidewalk edger
Radius edger
Pavement edger
Step-and-windowsill edger
Curb edger
Long-handled walking-type edger





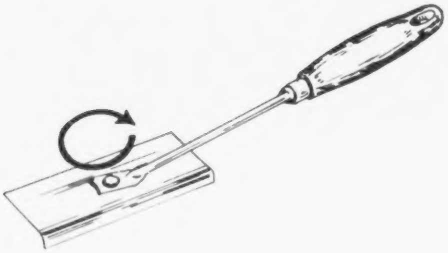
a. ____________________ b. ____________________



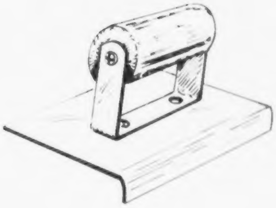


c. ____________________ d. ____________________

TEST



e. ______________________________



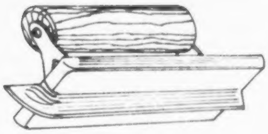
f. ______________________________

Types of jointers (groovers)

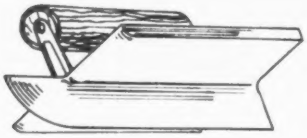
Deep-bit hand-type jointer

Small-bit hand-type jointer

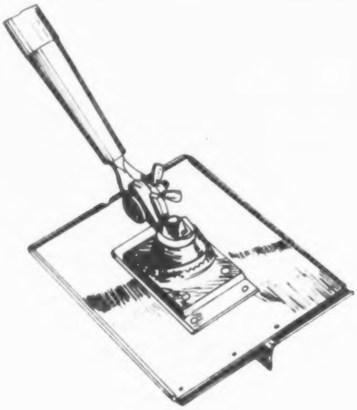
Long-handled walking-type jointer



a. ______________________________



b. ______________________________

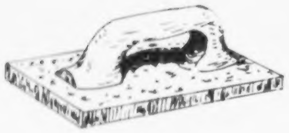


c. ______________________________

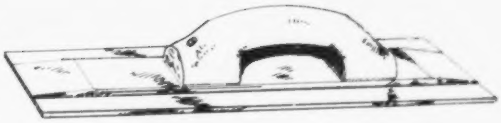
TEST

Types of hand floats

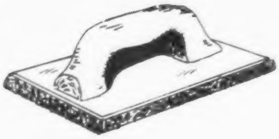
Common wood float
Common magnesium float
Special cork float
Special carpet float
Special rubber/sponge float



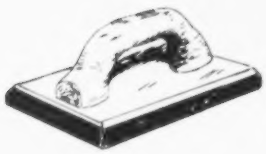
a. ____________________



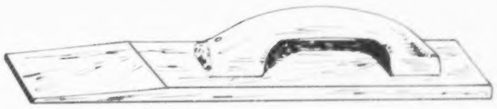
b. ____________________



c. ____________________



d. ____________________

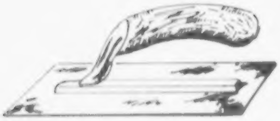


e. ____________________

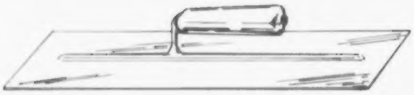
TEST

Types of trowels

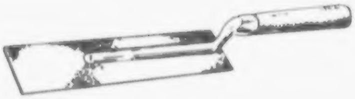
Finishing trowel   Midget trowel   Pipe trowel   Fresno trowel



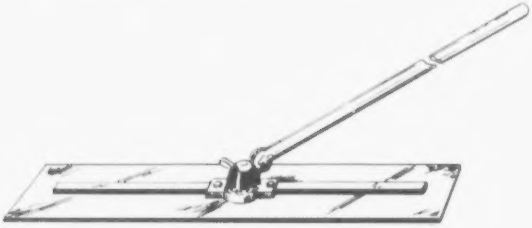
a. ______________________________



b. ______________________________



c. ______________________________

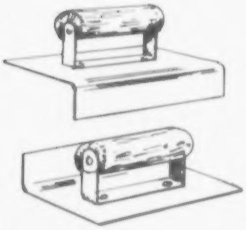


d. ______________________________

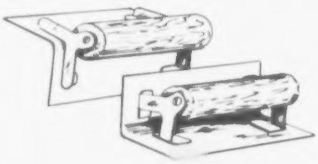
Types of combination tools

Edger/jointer   Curb-and-gutter tool   Step-and-sidewalk tool   Cove-and-base tool

Step-and-corner tool

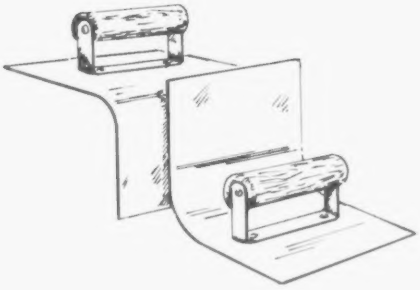


a. ______________________________



b. ______________________________

TEST



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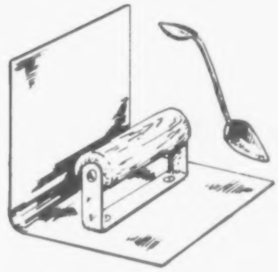
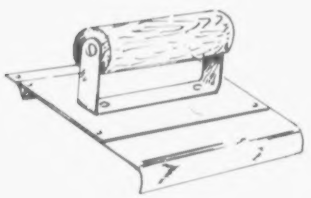
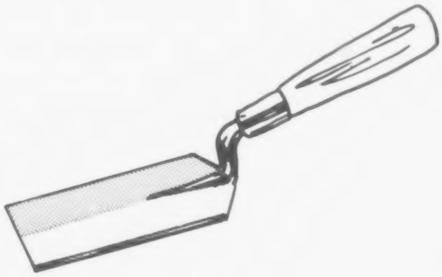
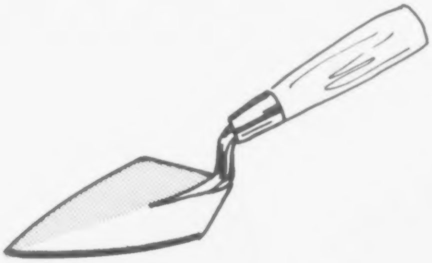




d. ______________________________ e. ______________________________

5. Label the following hand tools used for patching and mixing and concrete.

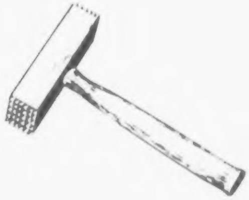


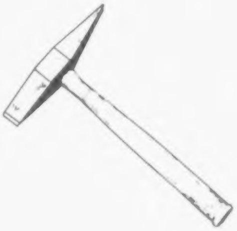


a. ______________________________ b. ______________________________

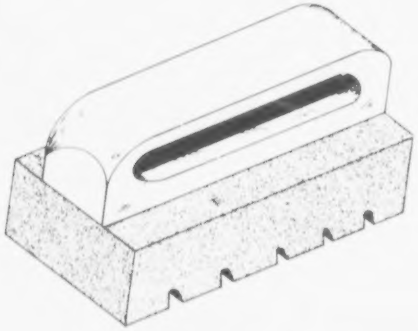
TEST

6. Label the following hand tools used for working with hardened concrete.



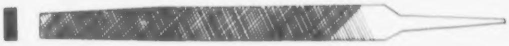


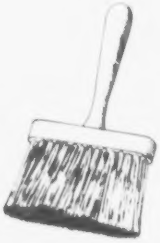
a. ______________________ b. ______________________



c. ____

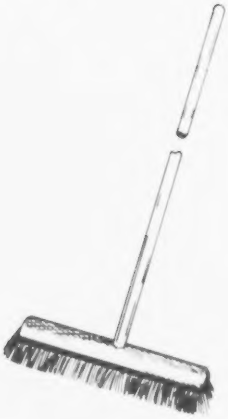
7. Label the following miscellaneous hand tools and equipment.

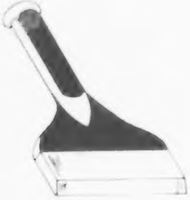




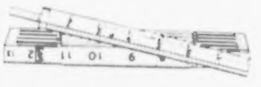
a. ______________________ b. ______________________

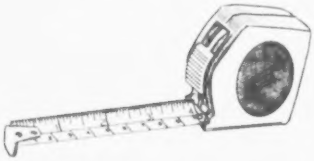
TEST





c. ______________________ d. ______________________





e. ______________________ f. ______________________

(NOTE: Test item 8 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

8. Demonstrate the ability to

   a. Use a bull float.

   b. Use a hand float and a finishing trowel.

   c. Use an edger.

   d. Dress edges of a finishing trowel.

HAND TOOLS
UNIT II

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 3
   d. 2
   e. 1
   f. 2
   g. 1
   h. 1
   i. 3
   j. 3

2. Answer should include any five of the following.

   a. Use the correct tool for the job
   b. Maintain tools properly
   c. Keep tools clean
   d. Inspect tools frequently to be sure they are in good condition
   e. Repair broken or damaged tools promptly
   f. Dispose of broken or damaged tools that cannot be repaired
   g. Store tools properly when not in use
   h. Wear eye, ear, and nose protection when necessary
   i. Stay alert when using tools
   j. *Do not* throw tools

3. a. Shovels — Used to place and puddle concrete alongside edge forms to prevent voids and honeycombing
   b. Straightedges — Used to rod concrete surface to a given grade
   c. Darbies — Used to darby concrete surface to eliminate any high or low spots or ridges left after rodding process
   d. Bull floats — Used on large concrete surfaces to eliminate any high or low spots or ridges left after rodding process
   e. Tampers (tamps) — Used on low-slump (1 inch or less) concrete to embed coarse aggregate just below concrete surface and to consolidate concrete surface
   f. Edgers — Used to form a radius at concrete-slab edges to improve appearance and reduce risk of damage to edges
   g. Jointers (groovers) — Used to cut joints (grooves) partly through fresh concrete to act as controls to predetermine location of possible cracks and to improve appearance
   h. Hand floats — Used to float concrete around hard-to-reach places and to prepare concrete surface for troweling
   i. Trowels — Used to give concrete surface a dense, smooth finish
   j. Combination tools — Used to do at least two jobs at the same time

4. **Types of straightedges**

   a. Paver's (highway) straightedge
   b. Common wood or magnesium straightedge
   c. Long-handled, 12-foot, adjustable-head straightedge

ANSWERS TO TEST

Types of darbies

a. Long-handled magnesium darby
b. Small magnesium darby
c. Wood darby

Types of bull floats

a. Wood bull float
b. Metal (magnesium or aluminum) bull float

Types of tampers (tamps)

a. Rollerbug
b. Jitterbug
c. Hand tamper

Types of edgers

a. Long-handled walking-type edger
b. Curb edger
c. Pavement edger
d. Radius edger
e. Step-and-windowsill edger
f. Sidewalk edger

Types of jointers (groovers)

a. Small-bit hand-type jointer
b. Deep-bit hand-type jointer
c. Long-handled walking-type jointer

Types of hand floats

a. Special cork float
b. Common magnesium float
c. Special carpet float
d. Special rubber/sponge float
e. Common wood float

Types of trowels

a. Midget trowel
b. Finishing trowel
c. Pipe trowel
d. Fresno trowel

Types of combination tools

a. Step-and-sidewalk tool
b. Step-and-corner tool
c. Curb-and-gutter tool
d. Cove-and-base tool
e. Edger/jointer

ANSWERS TO TEST

5. a. Margin trowel
   b. Pointing trowel

6. a. Bush hammer
   b. Chipping hammer
   c. Large-sized, fluted, 8"-×-3 1/2"-×-1 1/2" rubbing stone

7. a. Flat file
   b. Brush
   c. Finishing broom
   d. Chisel
   e. Folding rule
   f. Steel tape

8. Performance skills evaluated to the satisfaction of the instructor.

POWER TOOLS
UNIT III

UNIT OBJECTIVE

After competing this unit, the student should be able to identify and state uses of the power tools used by concrete masons. The student should also be able to state safety rules pertaining to these power tools and recognize guidelines for their proper care. The student will show this ability by completing the assignment sheet, job sheets, and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Match terms associated with power tools to their correct definitions.
2. State safety rules pertaining to power tools.
3. Select from a list guidelines for proper care of power tools.
4. State general uses of power straightedges.
5. Identify types of power straightedges.
6. State general uses of power tampers.
7. Label types of power tampers.
8. State general uses of power floats.
9. Label types of power floats.
10. Match types of power finishing machines to their specific uses.
11. Identify types of power finishing machines.
12. State general uses of power sprayers.
13. Identify types of power sprayers.
14. State general uses of power saws.
15. Identify types of power saws.
16. Match types of power grinders to their specific uses.
17. Identify types of power grinders.

OBJECTIVE SHEET

18. Complete a safety test pertaining to power tools.

19. Demonstrate the ability to

    a. Operate a trowel machine.

    b. Operate a ceiling grinder.

    c. Operate an electric sprayer.

POWER TOOLS
UNIT III

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Supplement #1 — Power Tool Crossword Puzzle

   D. Information sheet

   E. Assignment Sheet #1 — Complete a Safety Test Pertaining to Power Tools

   F. Answers to assignment sheet

   G. Job sheets

      1. Job Sheet #1 — Operate a Trowel Machine

      2. Job Sheet #2 — Operate a Ceiling Grinder

      3. Job Sheet #3 — Operate an Electric Sprayer

   H. Test

   I. Answers to test

II. Instructor's guide

   A. Review unit and plan presentation.

   B. Obtain materials to supplement unit.

      1. Audiovisual presentations

         (NOTE: All of the audiovisual presentations listed below are available from the Portland Cement Association, Order Processing, 5420 Old Orchard Road, Skokie, Illinois 60077; phone 312-966-6200.)

         a. *Concrete Tools and Finishing*. 50 slides, Portland Cement Association, n.d.; order number 55006.

            (NOTE: This slide set demonstrates the fundamental requirements of finishing concrete slabs on ground and includes basic tools, finishing techniques, and methods of obtaining special finishes.)

SUGGESTED ACTIVITIES

   b. *Placing and Finishing Concrete.* 37 slides, Portland Cement Association, 1980; order number 55289.09.

      (NOTE: This slide set is a portion of a much larger slide file called *Reference File III*; however, these thirty-seven slides are sold as an individual set as well as a part of the total reference file.)

   c. *Construction of a Concrete Industrial Floor on the Ground.* Film, 32 minutes, Portland Cement Association, 1979; order number 55266.

      (NOTE: This film discusses the requirements for a good, durable concrete floor, including base preparation, types of joints, proper handling of quality concrete, and step-by-step construction of a demonstration floor.)

   d. *Finishing and Curing Quality Concrete.* Film or video cassette, 27 minutes, Portland Cement Association, 1976; order number for film, PC200; order number for video cassette, VC200.

      (NOTE: This presentation illustrates the recommended practices for finishing and curing quality concrete and for producing attractive and durable surfaces on the concrete. Curing methods for attaining the best development of concrete strength and durability are emphasized.)

2. Poster for safety rules

3. Accident-report forms

4. Equipment and materials for job-sheet procedures

5. Samples of the equipment illustrated in the information sheet

6. Competency profiles

   (NOTE: Competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006; phone 202-393-2040.)

C. Introduce the unit by emphasizing the convenience of power tools over hand tools yet stressing the greater need for safe procedures when using power tools.

   SUGGESTION:

   - Take a field trip to a construction site where students may watch power tools in use. Have students take a notebook where they can write down safety rules and correct procedures they observe at the job site. Have students report their findings in class.

SUGGESTED ACTIVITIES

D. Provide students with objective sheet.

E. Discuss unit and specific objectives, emphasizing power-tool care and safety.

F. Provide students with information, assignment, and job sheets.

G. Discuss information, assignment, and job sheets.

   1. Use Information Sheet, Section I, to discuss terms and definitions associated with power tools.

   2. Use Information Sheet, Sections II and III, to discuss guidelines for proper care of power tools and safety rules pertaining to power tools.

      SUGGESTIONS:

      - Show the films and slide sets you have selected.
      - Discuss safety rules pertaining to power tools and guidelines for proper care of power tools. Review information about power-tool care and safety learned in films or slide sets.
      - Demonstrate proper care of power tools.
      - Display examples of power tools that have been improperly cared for or abused.
      - Discuss Assignment Sheet #1, "Complete a Safety Test Pertaining to Power Tools." Indicate that students must make 100 percent on this assignment sheet before they will be allowed to use power tools.
      - Explain your class and job-site policies for the use of power tools.
      - Review accident-report forms with students.
      - Post safety posters in the classroom and review with students.
      - Caution students not to fill the gas tank of a gasoline-powered tool while the machine is running.
      - Caution students not to run gasoline-powered tools indoors unless adequate ventilation has been provided.

   3. Use Information Sheet, Sections IV and V, to discuss uses of power straightedges and the types of power straightedges.

      SUGGESTIONS:

      - Display as many of the straightedges illustrated in the information sheet as possible.

SUGGESTED ACTIVITIES

- Discuss general uses of straightedges, and then discuss the specific uses of each type of straightedge.
- Demonstrate the proper handling of power straightedges. During the demonstration, caution students not to strain their backs as they are bending over and pulling great amounts of concrete with the straightedge. Show students the proper procedure of working with a shovel person when straightedging.
- Take a field trip to a construction site where students can watch concrete masons using power straightedges. Direct students to watch closely the technique the masons handling the straightedges and the people handling the shovels use when working together during the power straightedging process.
- Allow students to demonstrate proper handling of power straightedges. Observe student demonstrations and correct procedures as necessary.

4. Use Information Sheet, Sections VI and VII, to discuss types of power tampers and their uses.

   SUGGESTIONS:

   - Display as many of the power tampers illustrated in the information sheet as possible.
   - Discuss general uses of tampers, and then discuss the specific uses of each type of tamper.
   - Explain to students that power tampers are not furnished on many jobs, but that students should learn their use and become familiar with handling them just in case they are asked to use them.
   - Demonstrate the proper handling of power tampers, explaining that tampers are used much the same way as are bull floats.
   - Allow students to demonstrate proper handling of power tampers. Observe student demonstrations and correct procedures as necessary.

5. Use Information Sheet, Sections VIII through XI, to discuss types of power floats and their uses and types of power finishing machines and their uses.

   SUGGESTIONS:

   - Display as many of the power floats and finishing machines illustrated in the information sheet as possible.

SUGGESTED ACTIVITIES

- Discuss general uses of power floats and finishing machines, and then discuss the specific uses of each type of machine.
- Show students how to install the float blades on a trowel machine, and point out the various types of float blades that may be used on trowel machines.
- Demonstrate the proper handling of power floats and finishing machines.
    - —Caution students about getting too close to objects or edges with trowel machines and floats.
    - —Show students how to move the machines to the left and right: Gently raise up on the machine's handle to move it to the left, and gently lower the machine's handle to move it to the right.
    - —Show students that when floating and troweling, it is best to work at right angles to the bull-floating process. Also demonstrate how each successive floating or troweling process should be made at right angles to the previous process.
    - —Demonstrate the back-and-forth pattern followed across the slab when using power floats and finishing machines, and show students how to overlap passes by about one-half the width of the blade.
- Allow students to demonstrate proper handling of the machines. Observe student demonstrations and correct procedures as necessary.

6. Use Information Sheet, Sections XII and XIII, to discuss the types of power sprayers and their uses.

   SUGGESTIONS:

   - Display as many of the power sprayers illustrated in the information sheet as possible.
   - Discuss general uses of power sprayers.
   - Discuss specific uses of each type of sprayer.
   - Demonstrate the proper handling of power sprayers. Caution students not to use different types of liquids in the sprayers unless they clean the sprayer thoroughly before each new use—which should always be done anyway.
   - Allow students to demonstrate proper use of the sprayers. Observe student demonstrations and correct procedures as necessary.

SUGGESTED ACTIVITIES

7. Use Information Sheet, Sections XIV and XV, to discuss the types of power saws and their uses.

   SUGGESTIONS:

   - Display as many of the power saws illustrated in the information sheet as possible.
   - Discuss general uses of power saws, and then discuss specific uses of each type of saw.
   - Demonstrate the proper handling of power saws. Caution students to keep their feet away from the saw blades.
   - Allow students to demonstrate proper handling of the saws. Observe student demonstrations and correct procedures as necessary.

8. Use Information Sheet, Sections XVI and XVII, to discuss the types of power grinders and their uses.

   SUGGESTIONS:

   - Display as many of the power grinders illustrated in the information sheet as possible.
   - Discuss general uses of power grinders, and then discuss specific uses of each type of grinder.
   - Stress the importance of wearing safety equipment when working with power grinders—especially when using grinders on walls and ceilings.

     EXAMPLES: Eye protection, hard hat, gloves, long-sleeved shirt, respirators

   - Caution students about using ceiling grinders around electrical wiring.
   - Caution students to be positive that other workers are not present when they are cutting nails off ceilings with a ceiling grinder.
   - Demonstrate the proper handling of power grinders.
   - Allow each student to demonstrate proper handling of the grinders. Observe student demonstrations and correct procedures as necessary.

SUGGESTED ACTIVITIES

H. Have students complete Supplement #1, "Power Tool Crossword Puzzle."

I. Demonstrate job-sheet procedures and have students complete Job Sheets #1 through #3.

J. Give test.

K. Critique test and discuss in class.

L. Complete appropriate section of competency profiles.

III. Unit references

A. *Austin Vibra-Tamp Cement Concrete Surfacing Machine*. Colton, California: Austin Brothers Manufacturing Co., Inc., n.d.

B. *The Bantom*. Paso Robles, California: Forshel Ltd., n.d.

C. *Champion Con-Trowels*. St. Louis, Missouri: Champion Manufacturing Company, n.d.

D. *EDCO Model E-6 Edge and Base Grinder*. Silver Spring, Maryland: Equipment Development Co., n.d.

E. *Goldblatt Tool Company Tool Catalog*. Kansas City, Kansas: Goldblatt Tool Company, n.d.

F. *Gomaco Finishing Machine Flier*. Ida Grove, Iowa: Gomaco Corporation, n.d.

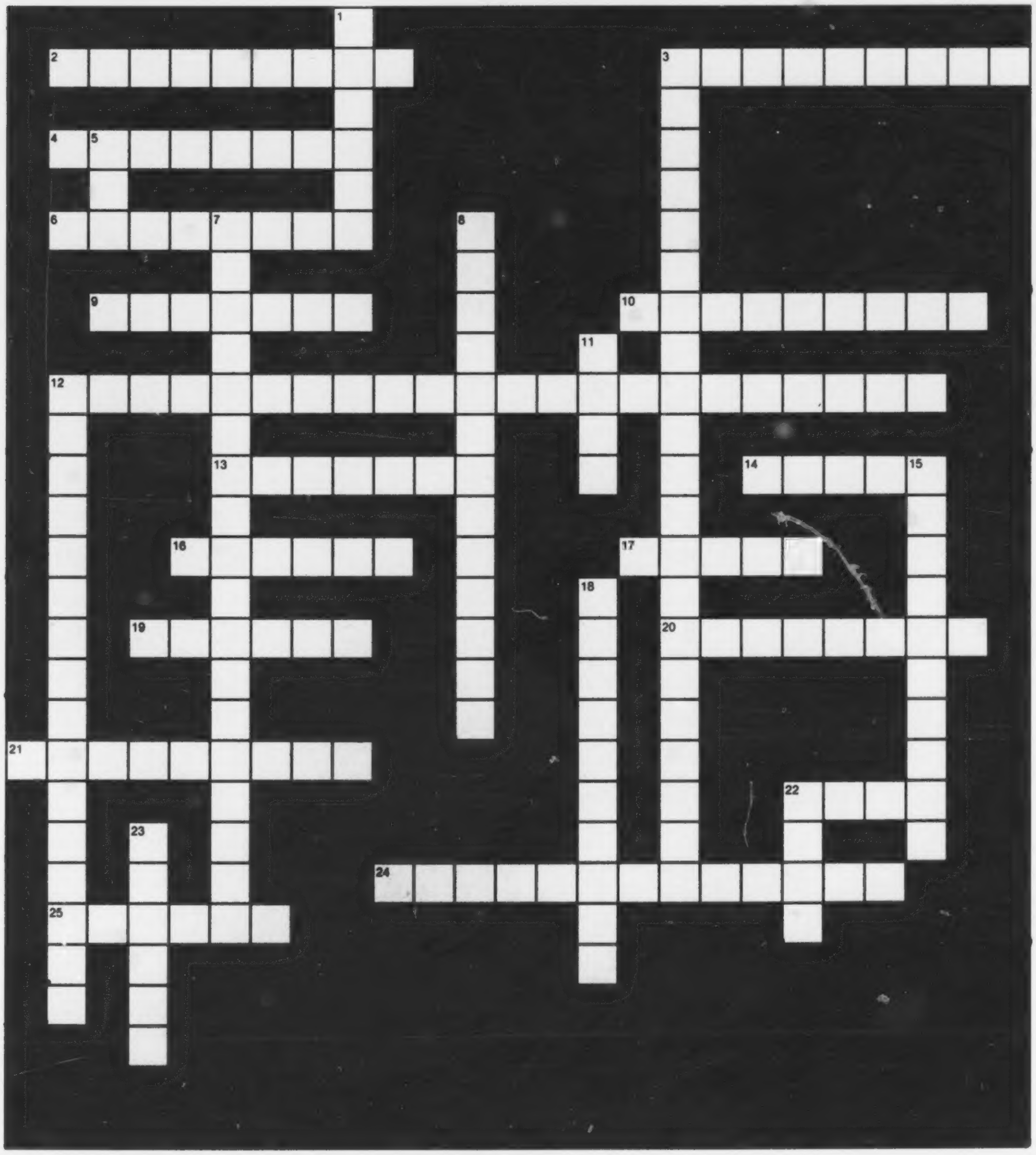
G. Hendrix, Laborn J. "Bud". *Cement Masonry Curriculum*. Stillwater, Oklahoma: Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1975.

H. *Stow Manufacturing Company Concrete Equipment Catalog*. Binghampton, New York: Stow Manufacturing Company, n.d.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — POWER TOOL CROSSWORD PUZZLE

Use the information sheet and the clues on the following page to complete the power tool crossword puzzle below.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SUPPLEMENT #1

ACROSS

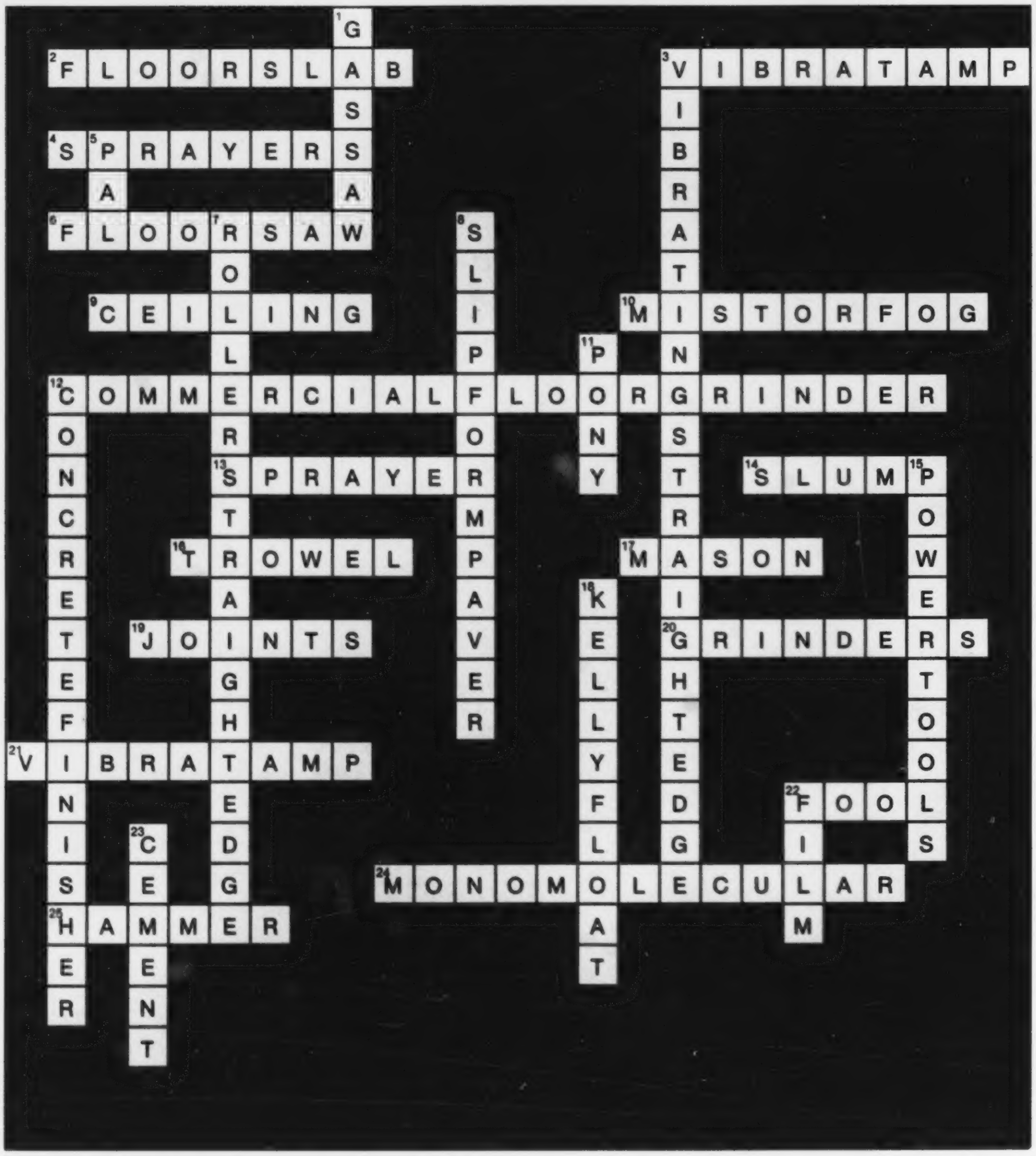
2. Any flat, horizontal concrete floor
3. Tool used on low-slump concrete to consolidate, level, and bring fines to concrete surface
4. Tools used to apply form oil, water, and curing compound to concrete surface
6. Type of medium-duty power saw
9. Type of grinder used to prepare ceiling for final finish
10. Forms of water sprayed on finished concrete until suitable curing can take place (3 words)
12. Type of power grinder (3 words)
13. Tool used to apply curing compounds on finished concrete
14. Consistency of fresh concrete
16. Tool used to finish concrete
17. Concrete ________________
19. Cuts in concrete to regulate location of cracking or for decorative purposes
20. Tools used to remove seams and projections on walls and to rub and to finish walls
21. See #3 across
22. Person lacking in judgment; deranged person lacking in common powers of understanding
24. ________________ film; compound sprayed on fresh concrete to reduce rapid evaporation
25. Hand tool used to drive and pull nails

DOWN

1. Type of portable saw *not* powered by electricity (2 words)
3. Type of heavy-duty straightedge (2 words)
5. Close friend—buddy
7. Type of power straightedge (2 words)
8. Type of power straightedge (2 words)
11. Type of finishing machine, a ________________ trowel
12. Type of large finishing machine used on pavement, bridges, parking areas, and airstrips (2 words)
15. Title of this unit
18. Type of power float (2 words)
22. Monomolecular________________
23. Main ingredient of concrete

SUPPLEMENT #1

Solution to Puzzle


2 FLOORSLAB
3 VIBRATAMP
4 S 5 PRAYERS
6 FLOO 7 RSAW
9 CEILING
10 MISTORFOG
12 COMMERCIALFLOORGRINDER
13 SPRAYER
14 SLUM 15 P
16 TROWEL
17 MASON
19 JOINTS
20 GRINDERS
21 VIBRATAMP
22 FOOL
24 MONOMOLECULAR
25 HAMMER
1 GASSAW
3 VIBRATINGSTRAIGHTEDGE
5 PA
7 ROLLERSTRAIGHTEDGE
8 SLIPFORMPAVER
11 PONY
12 CONCRETEFINISHER
15 POWERTOOLS
18 KELLYFLOAT
22 FILM
23 CEMENT

POWER TOOLS
UNIT III

INFORMATION SHEET

I. Terms and definitions associated with power tools

A. Occupational Safety and Health Act (OSHA) — Federal legislation designed to ensure safe and sanitary working conditions for employees

B. Curing compound — Liquid coating applied to newly placed concrete to maintain satisfactory moisture content and temperature in concrete during early stages so that desired concrete properties may develop

C. Control joint — Joint cut in concrete to regulate the location of cracking

D. Dummy joint — Joint cut in concrete for decorative purposes

E. Monomolecular film — Compound sprayed on fresh concrete to reduce rapid evaporation of moisture from concrete to maintain satisfactory moisture content during curing so that desired concrete properties may develop

F. Dry shake — Dry mixture of cement and fine aggregate that is worked evenly into surface of concrete flatwork before final setting takes place

G. Terrazzo — Marble or granite concrete mixture cast in place and ground smooth to create a decorative surface

H. Fin — Projection on formed concrete surface, resulting from mortar flowing into spaces in formwork

II. Safety rules pertaining to power tools

(NOTE: Power tools may be operated by electricity [AC or DC], air, combustion engines, or explosive powder.)

A. *Do not* attempt to operate any power tool without being certified by your instructor on that particular tool

B. Always wear appropriate safety equipment and protective clothing for job being done

EXAMPLES: Wear tight-fitting clothing that cannot become caught in the moving parts of the tool. Roll up long sleeves, tuck in shirttails, and tie back long hair.

C. *Do not* leave power tool running unattended

D. Assume a safe and comfortable position before starting a power tool

E. *Do not* distract others or let anyone distract you while operating a power tool

INFORMATION SHEET

F. Be sure that electric power tool is properly grounded before using

G. Be sure that power tool is *not* running before performing maintenance or changing accessories

H. *Do not* use dull or broken accessories

I. Use power tool only for its intended use

J. *Do not* use a power tool with guards or safety devices removed

K. Use proper extension cord of sufficient size to service particular electric tool you are using

L. *Do not* operate electrical power tool if your hands or feet are wet

M. Before attempting to use it, be familiar with the correct operation and adjustments of power tool

N. Keep a firm grip on power-float or trowel-machine handle while operating machine

O. Be sure there is proper ventilation before operating gasoline-powered equipment indoors

P. Keep fire extinguisher handy when filling and operating gasoline-powered equipment

(NOTE: OSHA requires that gasoline-powered equipment be turned off prior to filling with gasoline.)

Q. Lift heavy object with your legs—*not* with your back

R. Keep feet away from cutting tools such as concrete saws, grinders, and trowel-machine blades

III. Guidelines for proper care of power tools

A. Keep tools clean and in good working order

B. Follow manufacturer's maintenance procedures

C. Protect cutting edges

D. Keep tool accessories properly maintained

E. Report any unusual noises, sounds, or vibrations to the instructor or supervisor

F. Inspect tools and accessories regularly

G. Store tools properly when not in use

INFORMATION SHEET

H. Clean spraying equipment immediately after each job

I. Change trowel-machine blades when they become ragged

IV. General uses of power straightedges

(NOTE: Power straightedges are used on jobs such as sidewalks, floor slabs, pavement, bridges, slope paving, and runways to work concrete for the following purposes.)

A. To compact concrete

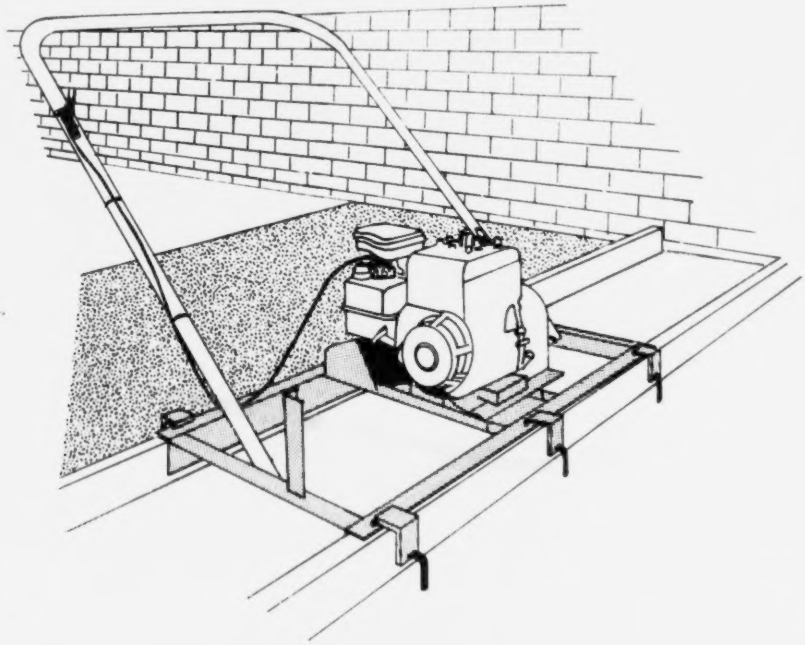
B. To bring concrete to desired grade

C. To prepare concrete for finishing procedures

V. Types of power straightedges (Figures 1-4)

A. Small portable power straightedge

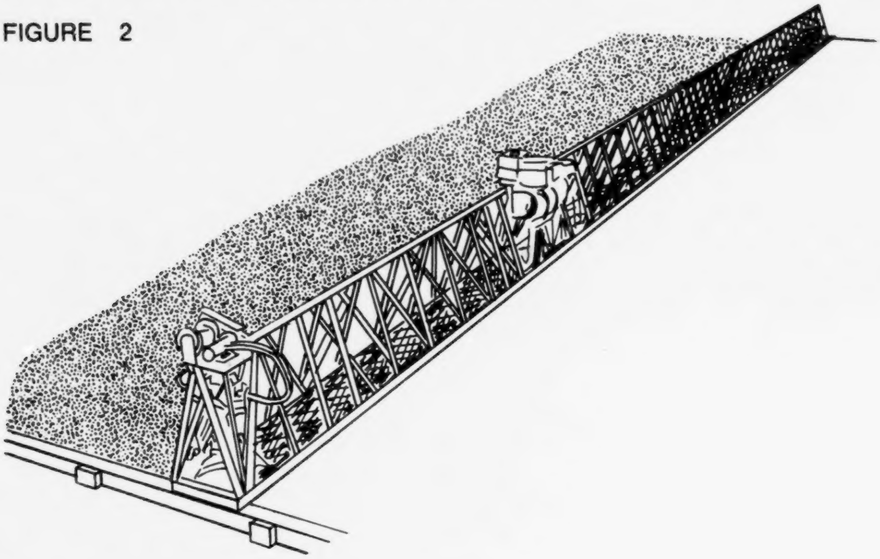
FIGURE 1



INFORMATION SHEET

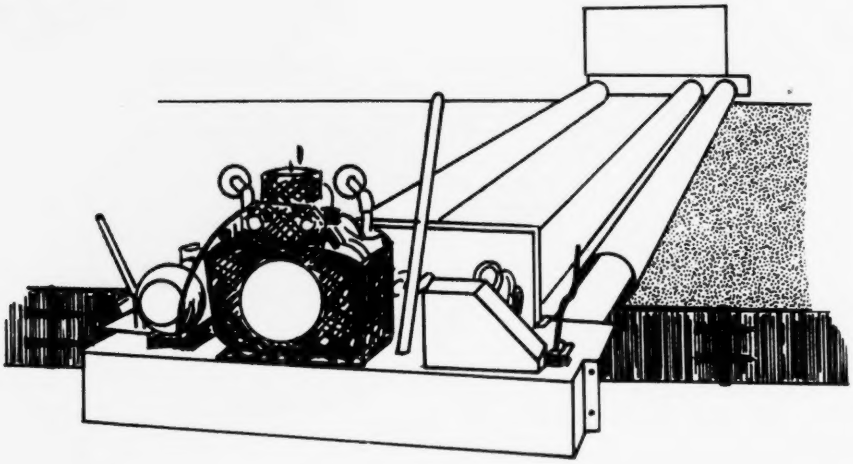
B. Heavy-duty vibrating-type power straightedge

FIGURE 2



C. Roller-type (tube-type) power straightedge

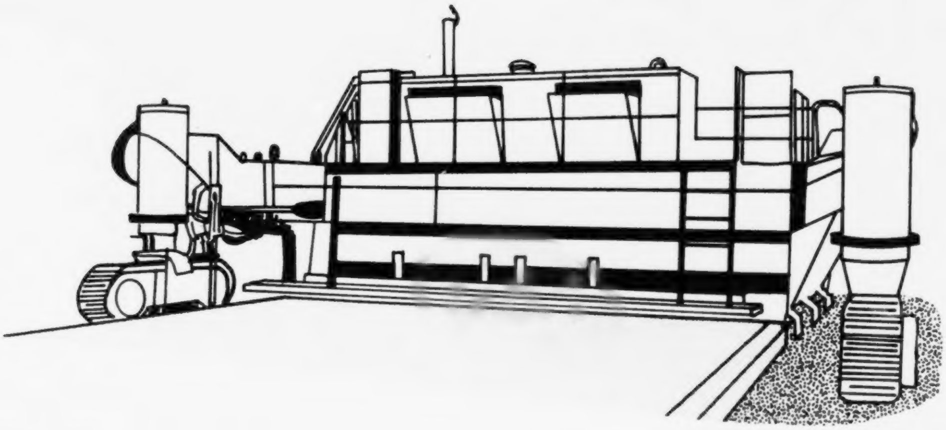
FIGURE 3



INFORMATION SHEET

D. Slip-form paver

FIGURE 4



VI. General uses of power tampers

A. To consolidate low-slump (1-inch or less) concrete slabs

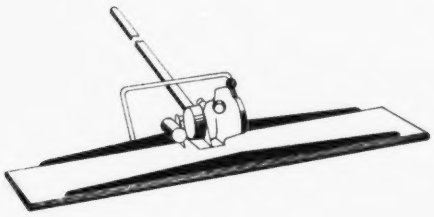
B. To bring fines to concrete surface

C. To level surface of fresh concrete

VII. Types of power tampers (Figures 5 and 6)

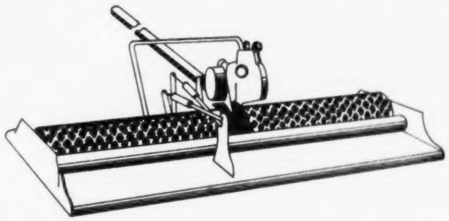
A. Vibrating bull float/tamper

FIGURE 5



B. Vibrating tamper (vibra tamp)

FIGURE 6



INFORMATION SHEET

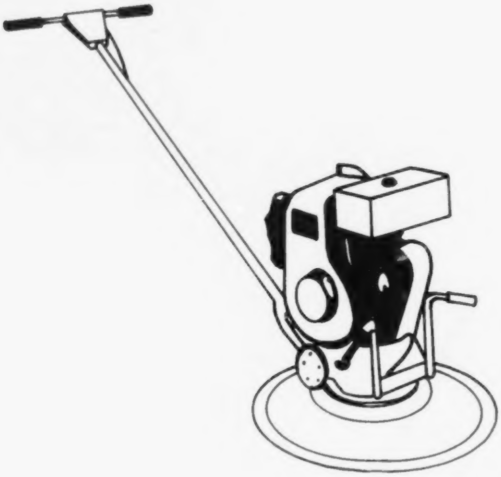
VIII. General uses of power floats

- A. To consolidate concrete
- B. To remove slight imperfections in concrete surface
- C. To bring fines to concrete surface
- D. To open concrete surface so that bleed water can escape
- E. To work dry-shake materials into concrete surface

IX. Types of power floats (Figures 7 and 8)

- A. Kelly float

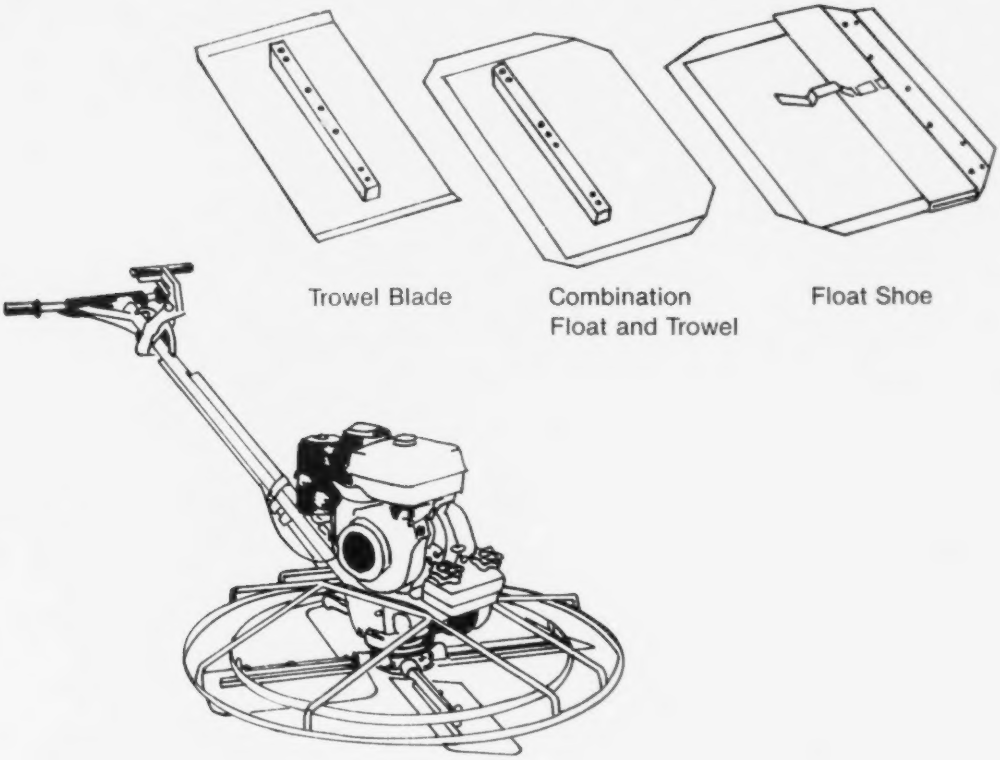
FIGURE 7



INFORMATION SHEET

B. Trowel machine with blade attachments

FIGURE 8



X. Specific uses for types of finishing machines

   A. Hand-held power trowel — Used to finish very small concrete slabs where it would be impractical to use other types of power trowels

   B. Pony trowel — Used to finish small concrete floor slabs where there are doorways to work through and obstacles to work around and between

   C. Trowel machine — Used to finish regular-sized concrete floor slabs and driveways that are relatively free of obstacles

   D. Riding trowel machine — Used to finish very large commercial-type concrete slabs

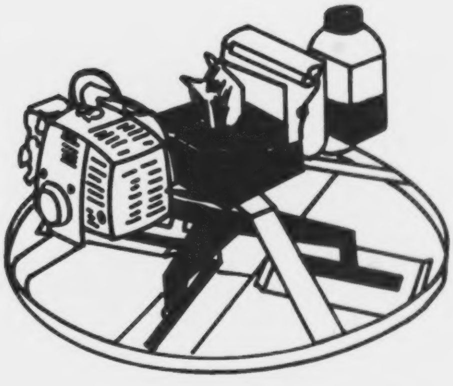
   E. Concrete finisher — Used to finish concrete for very large commercial-type jobs such as pavement, bridges, large parking areas, and airstrips

INFORMATION SHEET

XI. Types of power finishing machines (Figures 9 - 13)

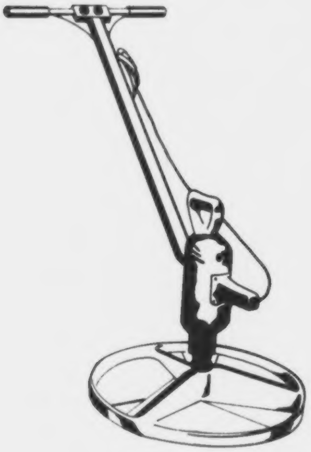
A. Hand-held power trowel

FIGURE 9



B. Pony trowel

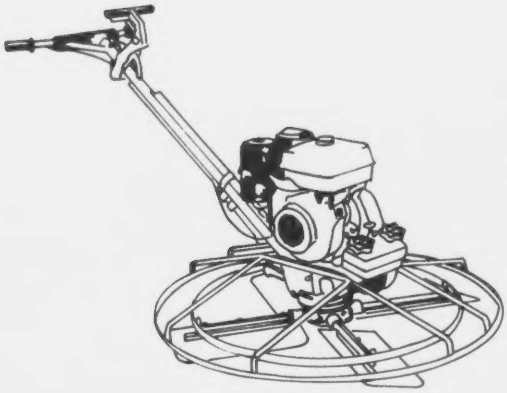
FIGURE 10



INFORMATION SHEET

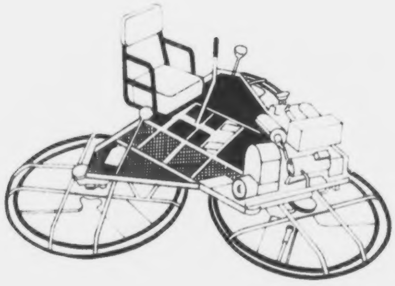
C. Trowel machine

FIGURE 11



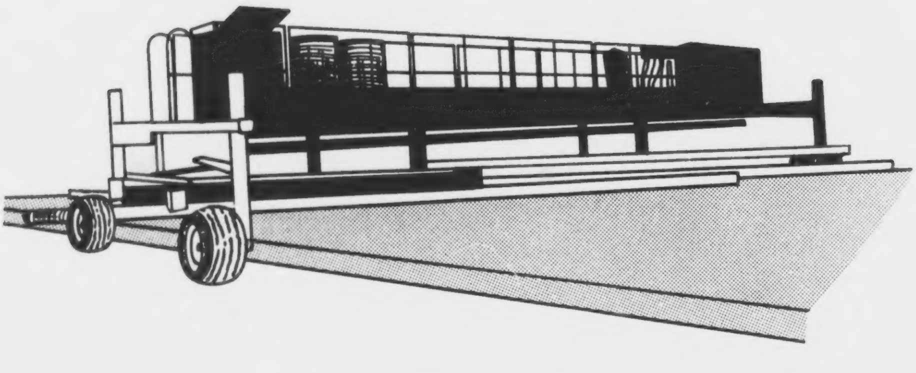
D. Riding trowel machine

FIGURE 12



E. Concrete finisher

FIGURE 13



INFORMATION SHEET

XII. General uses of power sprayers

A. To spray form oil on concrete forms

B. To spray curing compounds on finished concrete

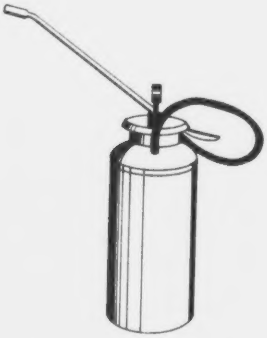
C. To spray monomolecular film on fresh concrete to reduce rapid evaporation

D. To mist or fog finished concrete with water until suitable curing can take place

XIII. Types of power sprayers (Figures 14 - 16)

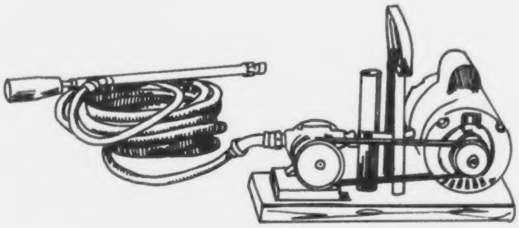
A. Hand-held tank sprayer

FIGURE 14



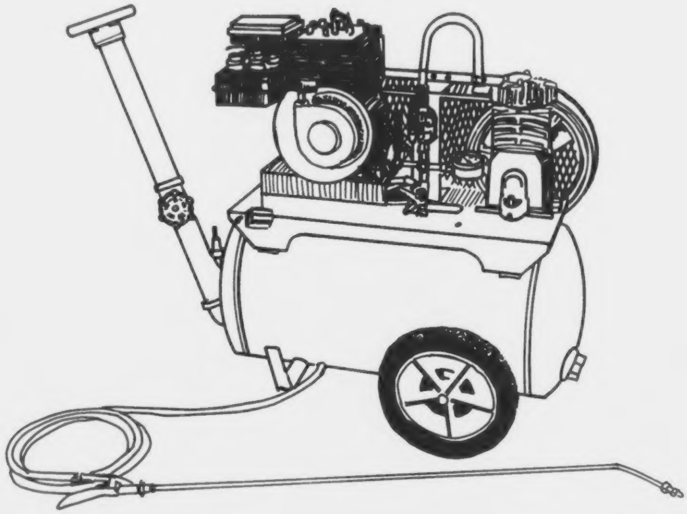
B. Electric-powered sprayer

FIGURE 15



C. Gasoline-powered sprayer

FIGURE 16



INFORMATION SHEET

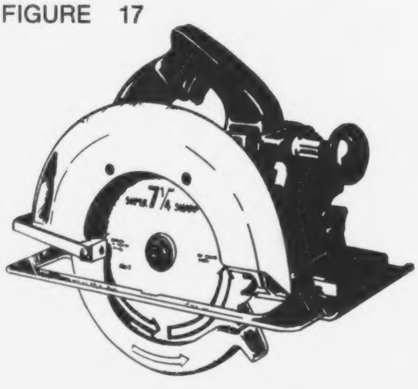
XIV. General uses of power saws

- A. To cut control joints in concrete
- B. To cut dummy joints in concrete
- C. To cut out sections of concrete for replacement
- D. To make cuts when demolishing concrete structures or slabs

XV. Types of power saws (Figures 17 - 20)

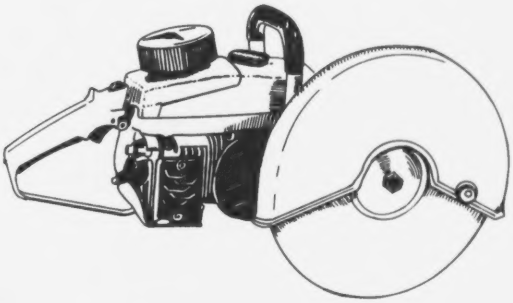
A. Portable electric-powered saw

FIGURE 17



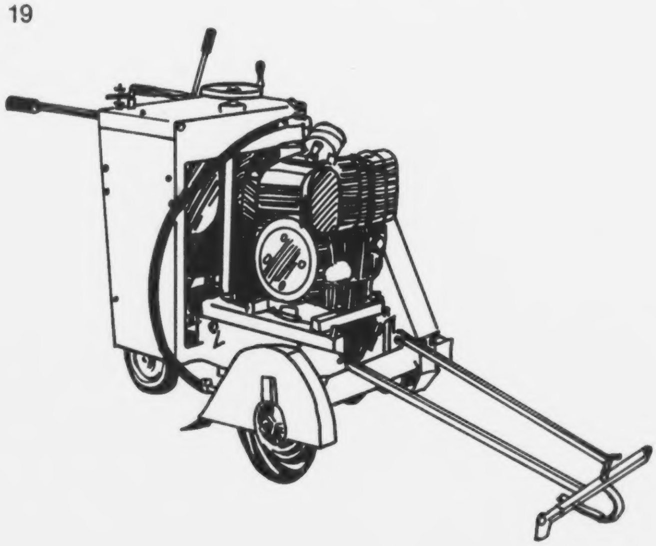
B. Portable gasoline-powered saw

FIGURE 18



C. Medium-duty floor-type power saw

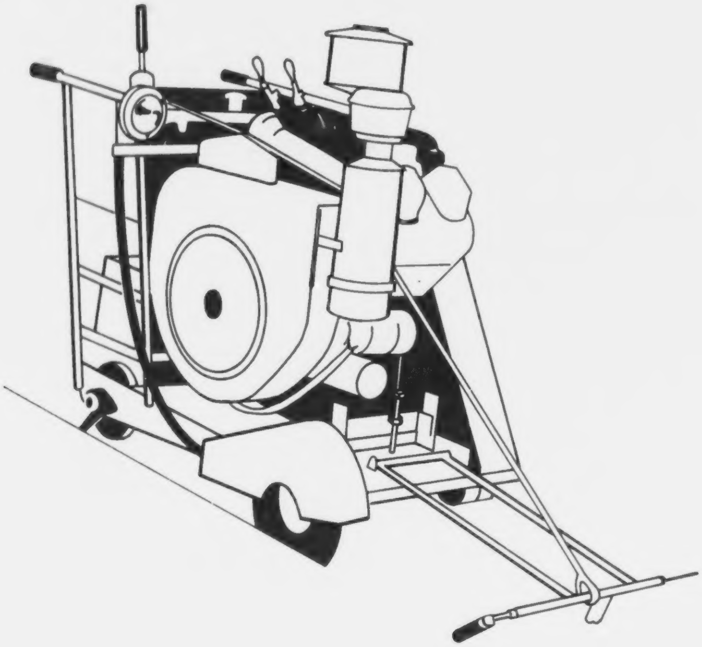
FIGURE 19



INFORMATION SHEET

D. Heavy-duty floor-type power saw

FIGURE 20



XVI. Specific uses for types of power grinders

A. Hand-held electric-powered grinder — Used to remove seams and projections on walls

B. Portable, flexible-hose, direct-drive, electric-powered grinder — Used to rub and to finish walls

C. Portable, vibrator-type, gasoline-powered grinder — Used to rub and to finish walls

D. Trowel machine with grinder head — Used to grind high spots from floors and pavement and to grind floors prior to refinishing

E. Commercial-type floor grinder — Used to grind high spots from floors and pavement and to grind floors prior to refinishing

F. Edge-and-base grinder — Used to grind floors along obstructions and to finish concrete and terrazzo base

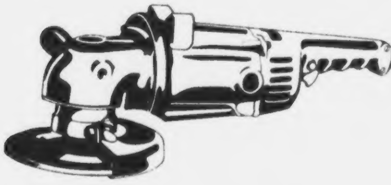
G. Ceiling grinder — Used to remove projections on concrete-ceiling surface and to prepare ceiling for final finishing

INFORMATION SHEET

XVII. Types of power grinders (Figures 21 - 27)

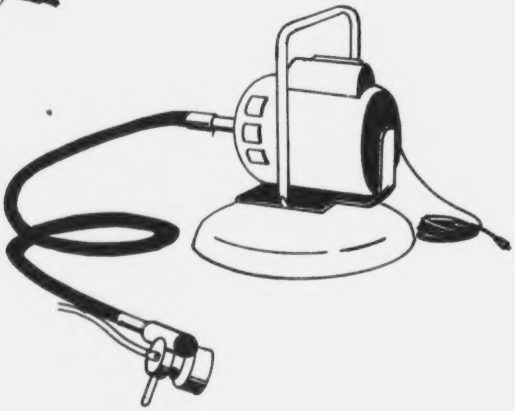
A. Hand-held electric-powered grinder

FIGURE 21



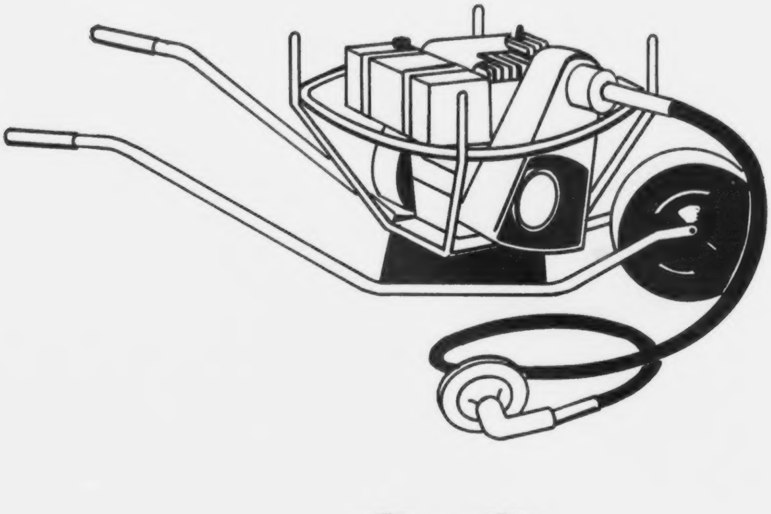
B. Portable, flexible-hose, direct-drive, electric-powered grinder

FIGURE 22



C. Portable, vibrator-type, gasoline-powered grinder

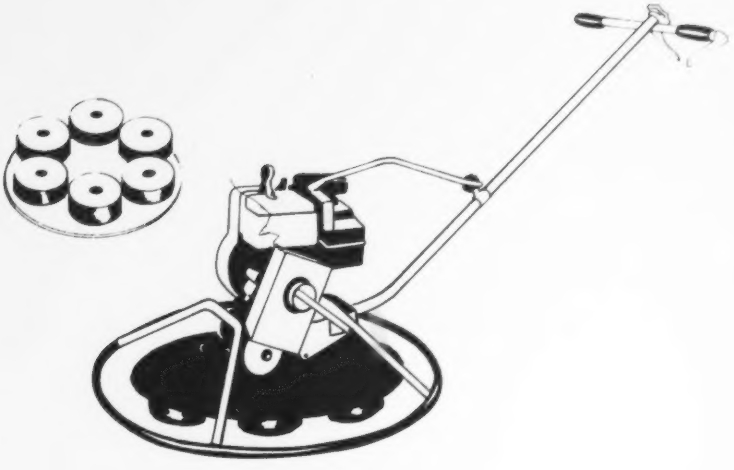
FIGURE 23



INFORMATION SHEET

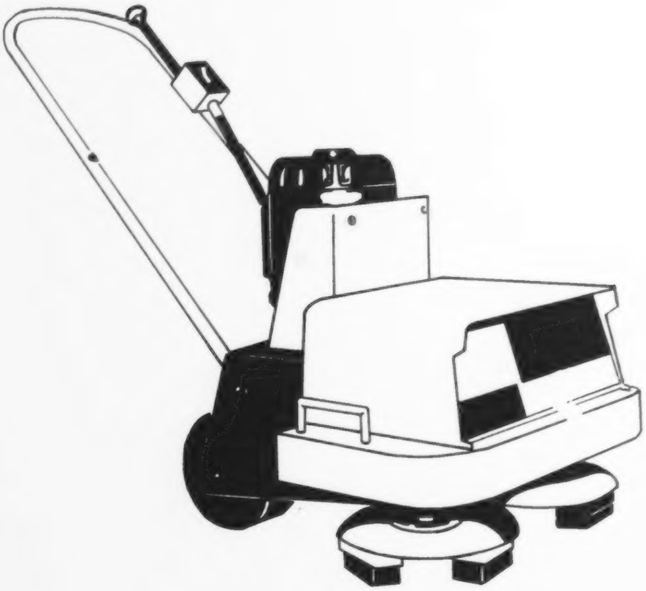
D. Trowel machine with grinder head

FIGURE 24



E. Commercial-type floor grinder

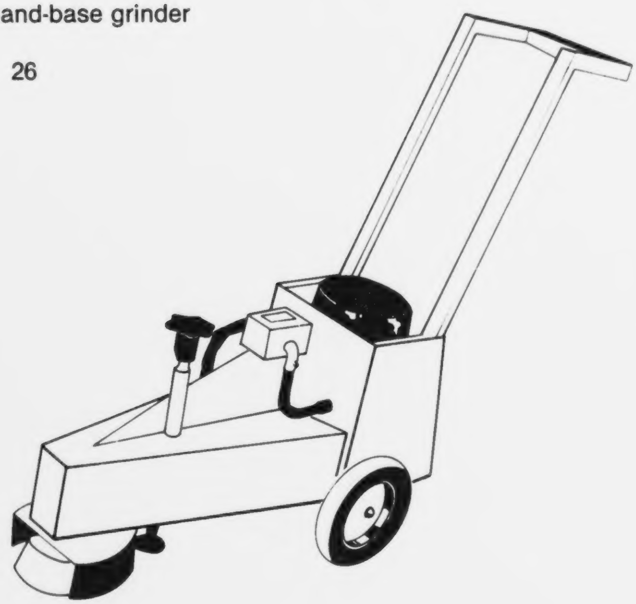
FIGURE 25



INFORMATION SHEET

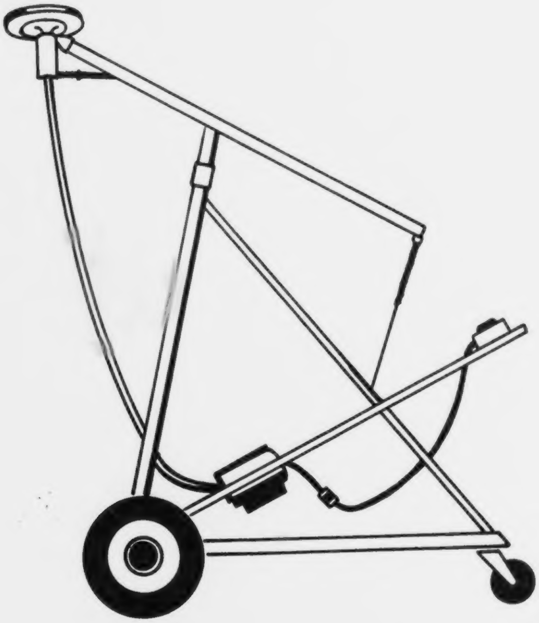
F. Edge-and-base grinder

FIGURE 26



G. Ceiling grinder

FIGURE 27



POWER TOOLS
UNIT III

ASSIGNMENT SHEET #1 — COMPLETE A SAFETY TEST PERTAINING TO POWER TOOLS

NAME ______________________________ SCORE ______________

To operate power tools safely, you must know the safety rules pertaining to power tools. Therefore, before you will be allowed to operate any power tool, you will be required to show you know the power-tool safety rules by scoring 100 percent on the safety test that follows.

Fill in the blanks to complete the following rules for safe use of power tools.

A. *Do not* attempt to operate any power tool without being ____________ by your instructor on that particular tool.

B. Always wear appropriate ____________ ____________ and ____________ ____________ for job being done.

C. *Do not* leave power tool running ____________ .

D. Assume a ____________ and ____________ position before starting a power tool.

E. *Do not* ____________ others or let anyone ____________ you while operating a power tool.

F. Be sure that electric power tool is properly ____________ before using.

G. Be sure that power tool is *not* ____________ before performing maintenance or changing accessories.

H. *Do not* use ____________ or ____________ accessories.

I. Use power tool *only* for its intended ____________ .

J. *Do not* use a power tool with ____________ or ____________ ____________ removed.

K. Use proper extension cord of sufficient ____________ to ____________ particular electric tool you are using.

ASSIGNMENT SHEET #1

L. *Do not* operate electrical power tool if your hands or feet are ________________ .

M. Before attempting to use it, be familiar with the correct ________________ and ________________ of power tool.

N. Keep a ________________ ________________ on power-float or trowel-machine handle while operating machine.

O. Be sure there is proper ________________ before operating gasoline-powered equipment indoors.

P. Keep fire extinguisher handy when ________________ and ________________ gasoline-powered equipment.

Q. Lift heavy object with your ________________ —*not* with your ________________ .

R. Keep ________________ away from cutting tools such as concrete saws, grinders, and trowel-machine blades.

POWER TOOLS
UNIT III

ANSWERS TO ASSIGNMENT SHEET

Assignment Sheet #1

A. Certified
B. Safety equipment; protective clothing
C. Unattended
D. Safe; comfortable
E. Distract; distract
F. Grounded
G. Running
H. Dull; broken
I. Use
J. Guards; safety devices
K. Size; service
L. Wet
M. Operation; adjustments
N. Firm grip
O. Ventilation
P. Filling; operating
Q. Legs; back
R. Feet

POWER TOOLS
UNIT III

JOB SHEET #1 — OPERATE A TROWEL MACHINE

I. Tools and equipment

A. Trowel machine with float shoes attached

B. Gasoline in gas can with funnel or spout

C. Can of oil and spout

D. Fire extinguisher

E. Hand trowel

F. Protective clothing

1. Hard hat

2. Long-sleeved shirt

3. Gloves

II. Procedures

A. Check trowel machine off slab

1. Visually check machine to be sure all guards, safety devices, and belts are in place and that blades are in good condition; notify instructor if repairs are necessary

2. Check gasoline and oil levels and fill if necessary

(NOTE: *Never* fill machine with gasoline or oil while machine is on the slab.)

B. Check to be sure there is proper ventilation

C. Check slab to be sure it is firm enough for floating and troweling procedures

(NOTE: The slab is ready for floating and troweling when an average-sized person leaves only a slight footprint impression on the surface of the concrete.)

D. Position trowel machine on slab at hardest point on slab

(NOTE: Usually the hardest point on the slab will be at the location where the concrete was first placed—at one corner of the slab and close to the edge form. See Figure 28.)

JOB SHEET #1

E. Adjust float blades for floating process: so that blades are almost flat

F. Start trowel machine

G. Make first floating pass, using the following guidelines

   1. Move machine across slab at right angle to direction of bull-floating process (See Figure 28)

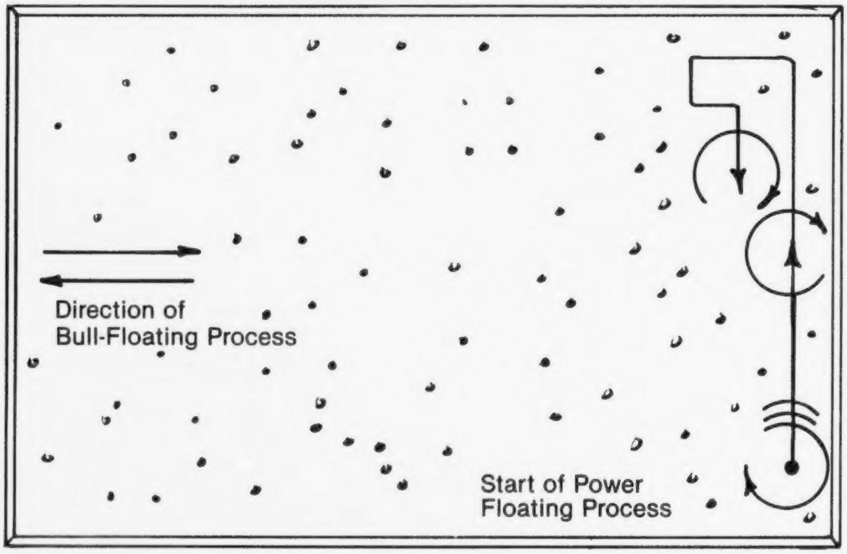
      a. Move machine right by gently pushing down on machine handle

      b. Move machine left by gently lifting machine handle

   2. *Do not* operate machine in one spot for any length of time as this tends to dish out a low place in the concrete

   3. Continue across slab until opposite edge is reached (Figure 28)

FIGURE 28



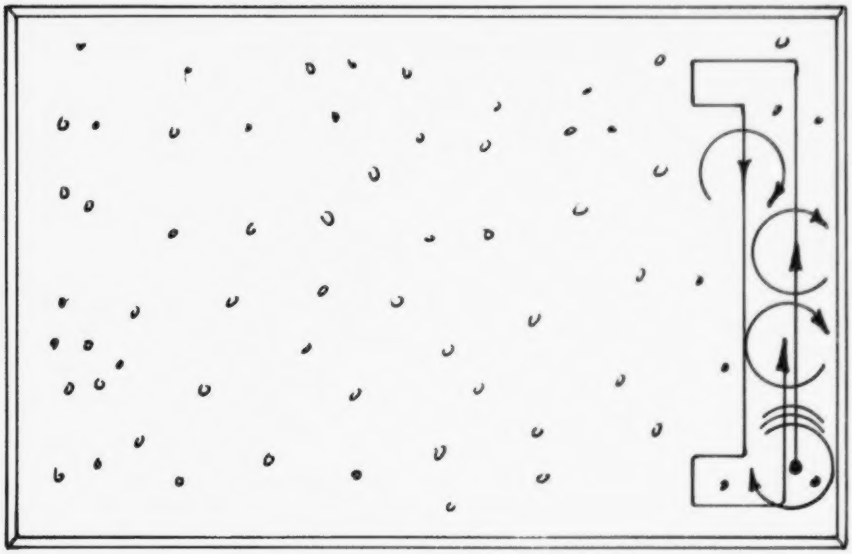
H. Immediately step back and maneuver trowel machine into position to make second floating pass, using the following guidelines

(NOTE: Remember *not* to operate machine in one spot for any length of time.)

JOB SHEET #1

1. Maneuver machine so that it will overlap first pass by about one-half the blade width (See Figure 29)
2. Move machine across slab at right angle to direction of bull-floating process (as in the first pass), but use a sweeping motion that follows a consistent pattern such as the pattern shown in Figure 29

FIGURE 29



3. As you move machine across slab, work out footprints and other imperfections

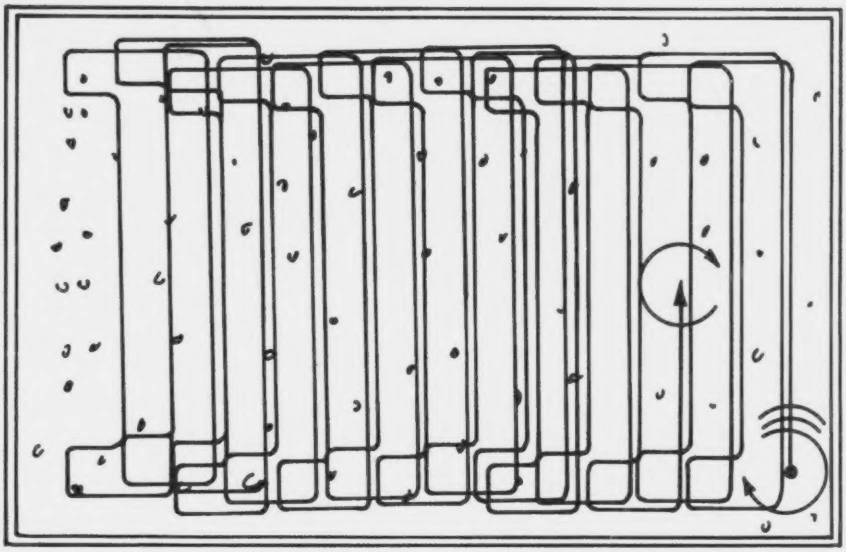
   (NOTE: Occasionally you may need to fill a hole by hand rather than by filling with the trowel machine. Carry a hand trowel in your pocket for this purpose.)

4. Continue across slab until opposite edge is reached

I. Continue making floating passes, following the procedures in Step H, until slab has been completely floated (See Figure 30)

JOB SHEET #1

FIGURE 30



J. Move trowel back to the starting position on slab

K. Remove float blades

L. Adjust trowel blades for first troweling process: so that blades are relatively flat

(NOTE: As concrete hardens, the blades should be tilted a little more with each successive troweling.)

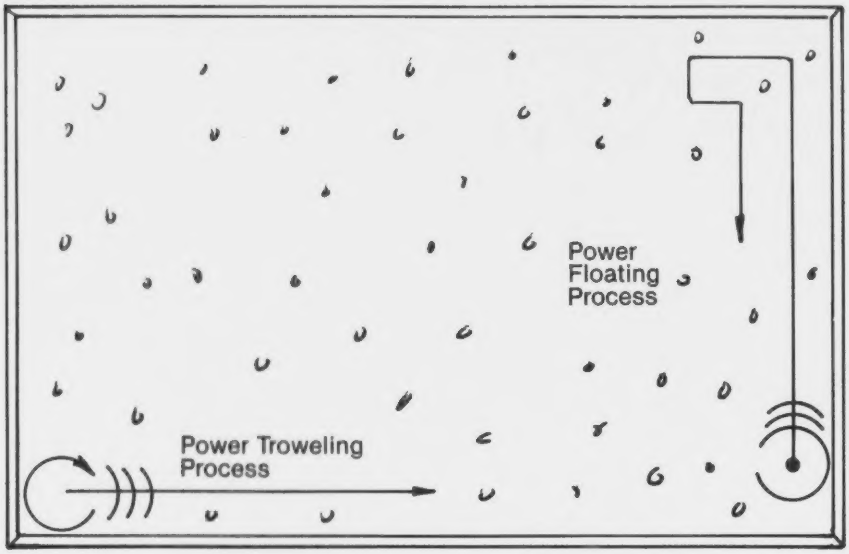
M. Start trowel machine

N. Make first troweling pass, using the following guidelines

1. Move machine across slab at right angle to direction of floating process (See Figure 31)
    a. Move machine right by gently pushing down on machine handle
    b. Move machine left by gently lifting machine handle
2. *Do not* operate machine in one spot for any length of time as this tends to dish out a low place in the concrete

JOB SHEET #1

FIGURE 31



3. Continue across slab until opposite edge is reached

O. Immediately step back and maneuver trowel machine into position to make second troweling pass, using the following guidelines

(NOTE: Remember *not* to operate machine in one spot for any length of time.)

1. Maneuver machine so that it will overlap first pass by about one-half the blade width

2. Move machine across slab at right angle to direction of floating process (as in first troweling pass), but use a sweeping motion that follows a consistent pattern

3. As you move machine across slab, work out footprints and other imperfections

   (NOTE: Occasionally you may need to fill a hole by hand rather than by filling with the trowel machine. Carry a hand trowel in your pocket for this purpose.)

4. Continue across slab until opposite edge is reached

P. Continue making troweling passes, following the procedures in Step O, until slab has been completely troweled one time

JOB SHEET #1

Q. Continue troweling process until desired finish is accomplished

(NOTE: The number of trowelings required and the waiting period between trowelings depends on the way the concrete sets and on the type of finish desired.)

R. Remove trowel machine from slab

S. Clean and properly store tools and equipment

POWER TOOLS
UNIT III

JOB SHEET #2 — OPERATE A CEILING GRINDER

I. Tools and equipment

   A. Ceiling grinder

   B. Extension cord of sufficient size

   C. Safety equipment and protective clothing

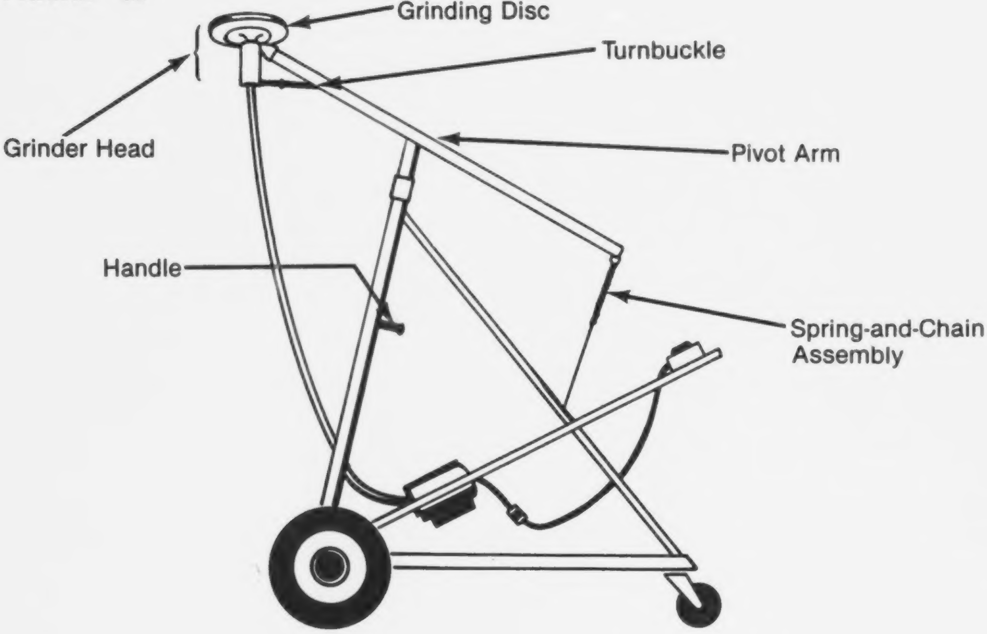
   (NOTE: Always wear safety equipment and protective clothing when using a ceiling grinder.)

      1. Hard hat
      2. Eye and face protection
      3. Respirator
      4. Gloves
      5. Long-sleeved shirt

II. Procedure

   A. Study illustration below to become familiar with the parts of a ceiling grinder (Figure 32)

FIGURE 32


Grinding Disc
Turnbuckle
Grinder Head
Pivot Arm
Handle
Spring-and-Chain Assembly

JOB SHEET #2

B. Check ceiling grinder and related equipment

   1. Visually check ceiling grinder to be sure all guards and safety devices are in place and grinder head is in good condition; notify instructor if repairs are necessary

   2. Check condition of extension cord and connections; replace as necessary

C. Check job-site floor to be sure that there are no existing obstructions or dangerous conditions; correct as necessary

D. Put on all safety equipment

E. Plug grinder into extension cord

F. Set grinder pivot arm at about a 45-degree angle

G. Adjust grinder head to proper height by lifting up on handle

H. Using spring-and-chain assembly at end of pivot arm, put a slight pressure on grinding disc to bring disc in contact with ceiling

I. Using turnbuckle, adjust disc to most desirable angle

J. Push up on pivot arm to bring disc out of contact with ceiling

CAUTION

Never start the grinder with the disc in contact with the ceiling.

K. Check to be sure everyone is clear

L. Start grinder motor and allow motor to reach maximum speed

M. Using pivot arm, gradually apply pressure to grinder head until it contacts ceiling

N. Move grinder in a back-and-forth motion to grind off nails, fins, and other obstructions until entire ceiling has been ground to a smooth finish

O. Clean work area and equipment, and properly store tools and equipment

POWER TOOLS
UNIT III

JOB SHEET #3 — OPERATE AN ELECTRIC SPRAYER

I. Tools and equipment

- A. Electric sprayer unit
- B. Heavy-duty spray nozzle
- C. Two sections of water hose to be used as inlet and outlet hoses for the sprayer unit

  (NOTE: The section of hose to be used as the outlet hose should be long enough to cover the area that is to be sprayed. The section of hose to be used as the inlet hose needs only to be long enough to reach from the sprayer unit into the curing-compound container.)

- D. Container of curing compound
- E. Extension cord of sufficient size
- F. Container of clean water
- G. Safety equipment and protective clothing
  1. Hard hat
  2. Goggles
  3. Gloves
  4. Long-sleeved shirt

II. Procedure

- A. Check electric sprayer unit and related equipment
  1. Visually check sprayer unit to be sure all guards and safety devices are in place; notify instructor if repairs are necessary
  2. Check condition of extension cord and connections; replace as necessary
  3. Check hoses and connections to make sure they are in good condition; replace as necessary
- B. Set sprayer unit near slab at location where it will be convenient to use; set container of curing compound and container of water beside sprayer unit

  (NOTE: If at all possible, you should *not* get on the slab while spraying. Spray while standing near the edge of the slab, and locate the sprayer unit where it will be convenient to do so.)

JOB SHEET #3

C. Plug sprayer unit into extension cord

D. Place end of inlet hose in container of curing compound

E. Put on safety equipment

F. Pick up outlet hose and point nozzle toward slab

G. Turn on sprayer unit and adjust nozzle so that curing compound will be distributed properly

(NOTE: With experience you will know when the nozzle is adjusted properly, but for now, check with your instructor before proceeding with the spraying process.)

H. Make first pass with sprayer, beginning at one end of slab and working back and forth across slab

I. Continue making passes until slab has been covered with curing compound

(NOTE: Sometimes it is necessary to cover slab with a second coat of curing compound. If this is necessary, make passes at right angle to passes in first spray pattern.)

J. Just before slab has been completely covered with compound, remove inlet hose from curing-compound container to begin clearing compound from hose and sprayer unit

K. Place inlet hose in container of water, point nozzle away from slab, and continue running pump until water coming from inlet hose is free of curing compound

CAUTION

Do *not* spray water onto slab.

(NOTE: Some curing compounds are colored, and you will be able to tell by looking at the water coming from the outlet hose when the water is clear of compound. However, some curing compounds are clear, and you will have to feel and smell the water coming from the outlet hose to determine when the water is clear of compound.)

L. Turn off sprayer unit

M. Clean work area and equipment, and properly store tools and equipment

POWER TOOLS
UNIT III

TEST

NAME ____________________ SCORE __________

1. Match terms associated with power tools to their correct definitions. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a. Marble or granite concrete mixture cast in place and ground smooth to create a decorative surface

1. Dry shake
2. Terrazzo
3. Fin

_____b. Dry mixture of cement and fine aggregate that is worked evenly into surface of concrete flatwork before final setting takes place

1. Dry shake
2. Terrazzo
3. Fin

_____c. Joint cut in concrete to regulate the location of cracking

1. Finish joint
2. Control joint
3. Dummy joint

_____d. Joint cut in concrete for decorative purposes

1. Finish joint
2. Control joint
3. Dummy joint

_____e. Projection on formed concrete surface, resulting from mortar flowing into spaces in formwork

1. Control joint
2. Fin
3. Dry shake

_____f. Liquid coating applied to newly placed concrete to maintain satisfactory moisture content and temperature in concrete during early stages so that desired concrete properties may develop

1. Monomolecular film
2. Curing compound
3. Terrazzo

_____g. Compound sprayed on fresh concrete to reduce rapid evaporation of moisture from concrete to maintain satisfactory moisture content during curing so that desired concrete properties may develop

1. Monomolecular film
2. Curing compound
3. Terrazzo

_____h. Federal legislation designed to ensure safe and sanitary working conditions for employees

1. Occupational Safety and Health Act
2. Job Safety Act
3. Workmen's Compensation

TEST

2. State eight safety rules pertaining to power tools.

a. ____

____

b. ____

____

c. ____

____

d. ____

____

e. ____

____

f. ____

____

g. ____

____

h. ____

____

3. Select from the following list guidelines for proper care of power tools. Write an "X" in the blank before each correct answer.

_____a. Protect cutting edges

_____b. Clean spraying equipment at least once a week

_____c. Keep tool accessories properly maintained

_____d. Change trowel-machine blades at least twice a year

_____e. Keep tools clean and in good working order

_____f. Inspect tools and accessories upon occasion

_____g. Report any unusual noises, sounds, or vibrations to the custodian

_____h. Keep tools in the classroom when not in use

_____i. Follow manufacturer's maintenance procedures

TEST

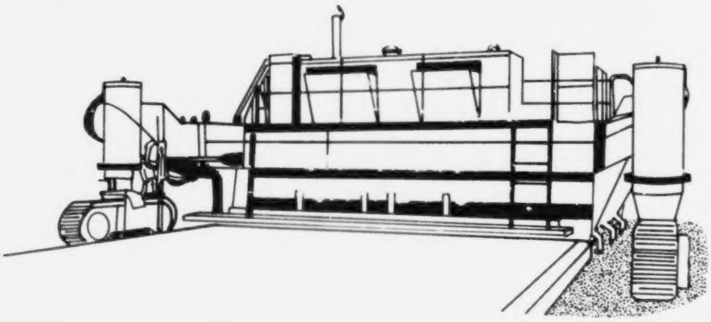
4. State two general uses of power straightedges.

   a. ______________________________

   b. ______________________________

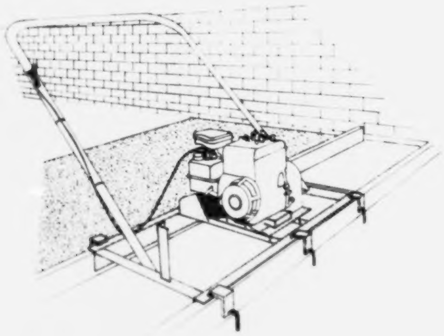
5. Identify the types of power straightedges illustrated below and on the following page. Write the correct names in the blanks.

Heavy-duty vibrating-type power straightedge
Slip-form paver
Roller-type (tube-type) power straightedge
Small portable power straightedge



a. ______________________________

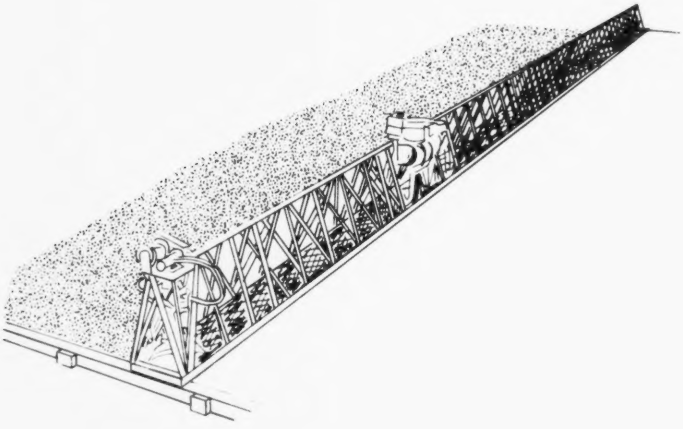
____



b. ______________________________

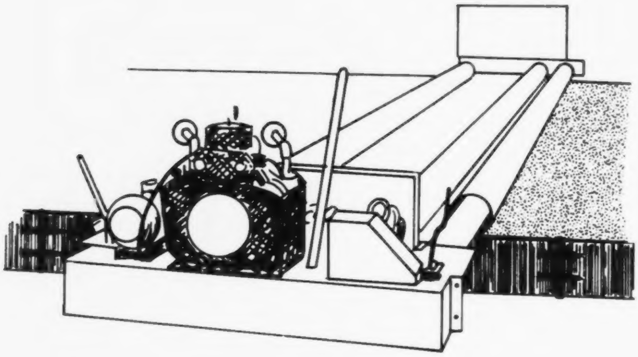
____

TEST



c. ______________________________

____



d. ______________________________

____

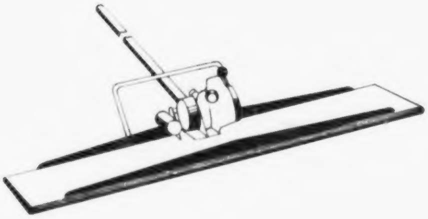
6. State two general uses of power tampers.

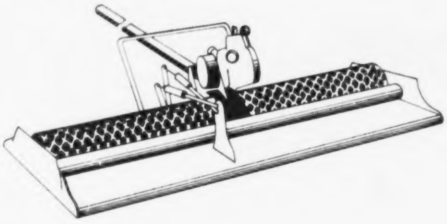
   a. ______________________________

   b. ______________________________

TEST

7. Label the types of power tampers illustrated below.





a. ______________________ b. ______________________

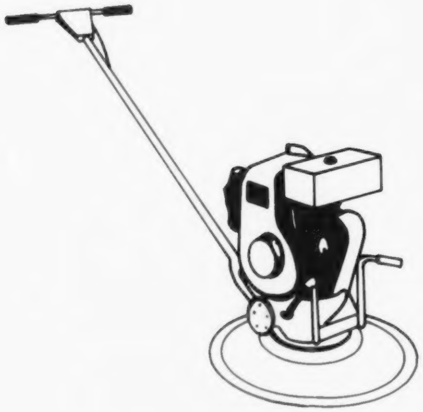
8. State three general uses of power floats.

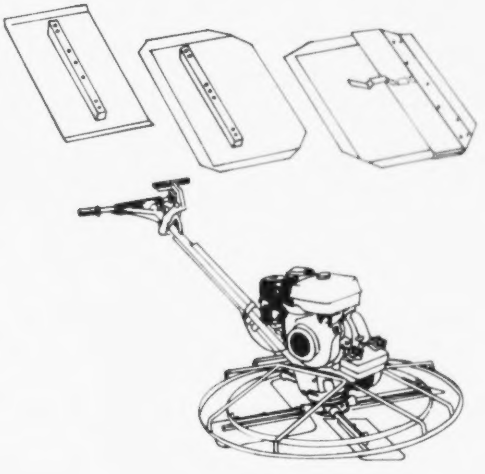
a. ____

b. ____

c. ____

9. Label the types of power floats illustrated below.





a. ______________________ b. ______________________

______________________ ______________________

TEST

10. Match types of power finishing machines to their specific uses. Write the correct numbers in the blanks.

_____a. Used to finish very small concrete slabs where it would be impractical to use other types of power trowels

_____b. Used to finish small concrete floor slabs where there are doorways to work through and obstacles to work around and between

_____c. Used to finish regular-sized concrete floor slabs and driveways that are relatively free of obstacles

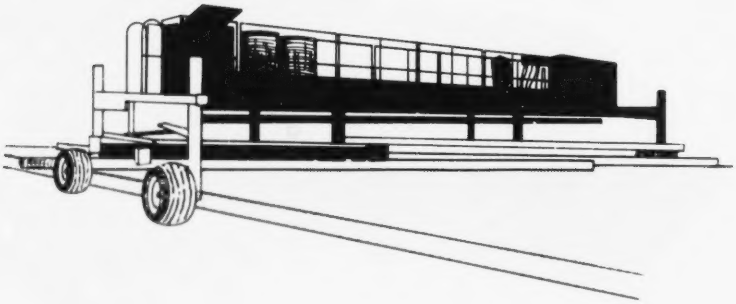
_____d. Used to finish very large commercial-type jobs such as pavement, bridges, large parking areas, and airstrips

_____e. Used to finish very large commercial-type concrete slabs

1. Trowel machine
2. Concrete finisher
3. Hand-held power trowel
4. Riding trowel machine
5. Pony trowel

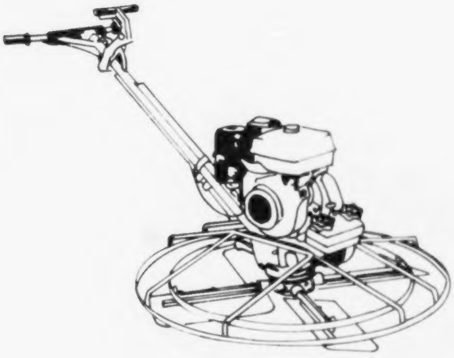
11. Identify the types of power finishing machines illustrated below and on the following page. Write the correct names in the blanks.

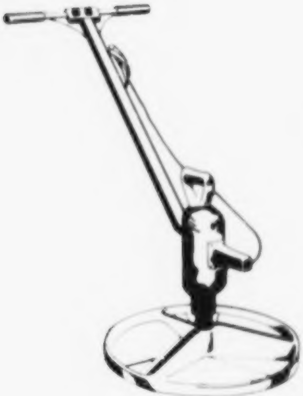
Concrete finisher
Riding trowel machine
Hand-held power trowel
Pony trowel
Trowel machine



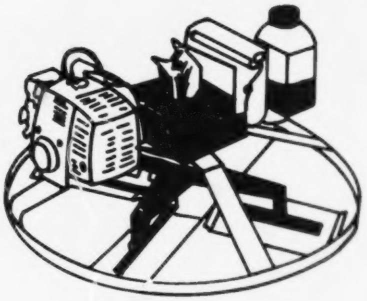
a. ______________________________

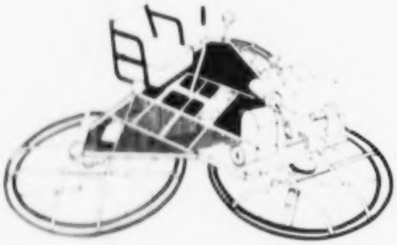
TEST





b. ____________________ c. ____________________





d. ____________________ e. ____________________

12. State three general uses of power sprayers.

a. ____

____

b. ____

____

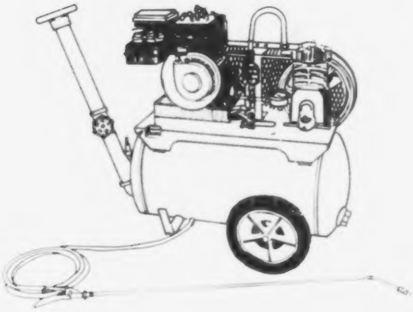
c. ____

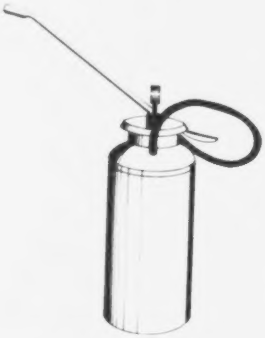
____

TEST

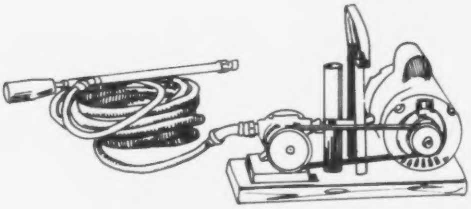
13. Identify the types of power sprayers illustrated below. Write the correct names in the blanks.

Electric-powered sprayer **Hand-held tank sprayer** **Gasoline-powered sprayer**





a. ______________________________ b. ______________________________



c. ______________________________

14. State three general uses of power saws.

a. ______________________________

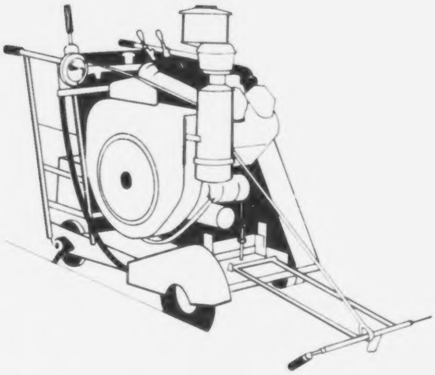
b. ______________________________

c. ______________________________

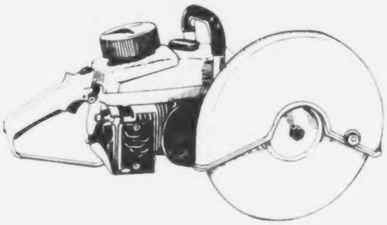
TEST

15. Identify the types of power saws illustrated below. Write the correct names in the blanks.

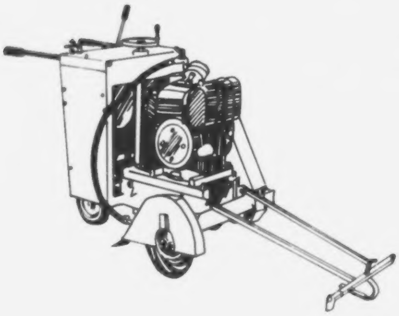
Medium-duty floor-type power saw
Portable gasoline-powered saw
Portable electric-powered saw
Heavy-duty floor-type power saw



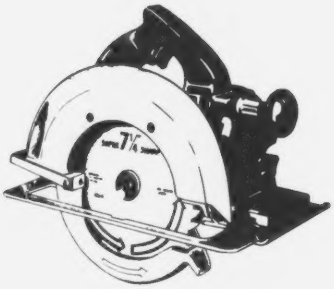
a.



b.



c.



d.

TEST

16. Match types of power grinders to their specific uses. Write the correct numbers in the blanks. Some blanks may contain more than one correct answer.

    1. Hand-held electric-powered grinder
    2. Portable, vibrator-type, gasoline-powered grinder
    3. Portable, flexible-hose, direct-drive electric-powered grinder
    4. Trowel machine with grinder head
    5. Commercial-type floor grinder
    6. Edge-and-base grinder
    7. Ceiling grinder

    ________a. Used to rub and to finish walls

    ________b. Used to grind floors along obstructions and to finish concrete and terrazzo base

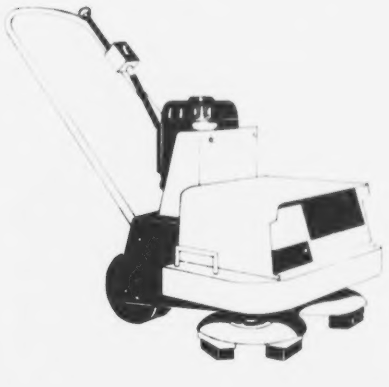
    ________c. Used to remove seams and projections on walls

    ________d. Used to remove projections on concrete-ceiling surface and to prepare ceiling for final finishing

    ________e. Used to grind high spots from floors and pavement and to grind floors prior to refinishing

17. Identify the types of power grinders illustrated below and on the following pages. Write the correct names in the blanks.

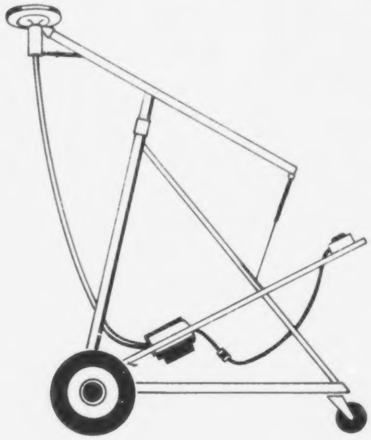
Edge-and-base grinder
Commercial-type floor grinder
Trowel machine with grinder head
Portable, flexible-hose, direct-drive, electric-powered grinder
Portable, vibrator-type, gasoline-powered grinder
Ceiling grinder
Hand-held electric-powered grinder



a. ________________________________

____

____

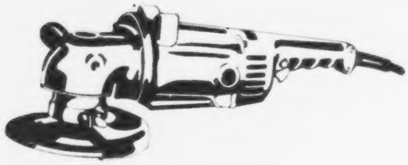


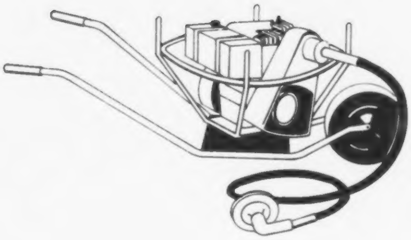
b. ________________________________

____

____

TEST





c. ______________________________

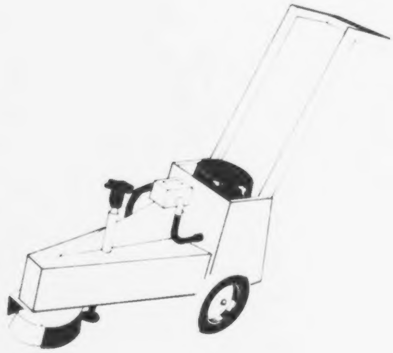
____

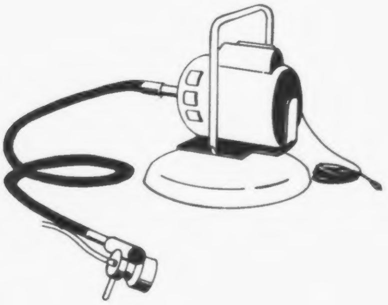
____

d. ______________________________

____

____





e. ______________________________

____

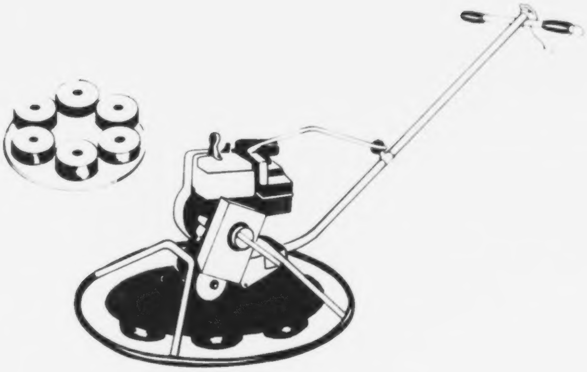
____

f. ______________________________

____

____

TEST



g. ______________________________

____

____

(NOTE: Test items 18 and 19 list the assignment and job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

18. Complete a safety test pertaining to power tools.

19. Demonstrate the ability to

    a. Operate a trowel machine.

    b. Operate a ceiling grinder.

    c. Operate an electric sprayer.

POWER TOOLS
UNIT III

ANSWERS TO TEST

1. a. 2
   b. 1
   c. 2
   d. 3
   e. 2
   f. 2
   g. 1
   h. 1

2. Answer should include any eight of the following.

   a. *Do not* attempt to operate any power tool without being certified by your instructor on that particular tool
   b. Always wear appropriate safety equipment and protective clothing for job being done
   c. *Do not* leave power tool running unattended
   d. Assume a safe and comfortable position before starting a power tool
   e. *Do not* distract others or let anyone distract you while operating a power tool
   f. Be sure that electric power tool is properly grounded before using
   g. Be sure that power tool is *not* running before performing maintenance or changing accessories
   h. *Do not* use dull or broken accessories
   i. Use power tool only for its intended use
   j. *Do not* use a power tool with guards or safety devices removed
   k. Use proper extension cord of sufficient size to service particular electric tool you are using
   l. *Do not* operate electrical power tool if your hands or feet are wet
   m. Before attempting to use it, be familiar with the correct operation and adjustments of power tool
   n. Keep a firm grip on power-float or trowel-machine handle while operating machine
   o. Be sure there is proper ventilation before operating gasoline-powered equipment indoors
   p. Keep fire extinguisher handy when filling and operating gasoline-powered equipment
   q. Lift heavy object with your legs—*not* with your back
   r. Keep feet away from cutting tools such as concrete saws, grinders, and trowel-machine blades

3. a, c, e, i

4. Answer should include any two of the following.

   a. To compact concrete
   b. To bring concrete to desired grade
   c. To prepare concrete for finishing procedures

ANSWERS TO TEST

5. a. Slip-form paver
   b. Small portable power straightedge
   c. Heavy-duty vibrating-type power straightedge
   d. Roller-type (tube-type) power straightedge

6. Answer should include any two of the following.

   a. To consolidate low-slump (1-inch or less) concrete slabs
   b. To bring fines to concrete surface
   c. To level surface of fresh concrete

7. a. Vibrating bull float/tamper
   b. Vibrating tamper (vibra tamp)

8. Answer should include any three of the following.

   a. To consolidate concrete
   b. To remove slight imperfections in concrete surface
   c. To bring fines to concrete surface
   d. To open concrete surface so that bleed water can escape
   e. To work dry-shake materials into concrete surface

9. a. Kelly float
   b. Trowel machine with blade attachments

10. a. 3
    b. 5
    c. 1
    d. 2
    e. 4

11. a. Concrete finisher
    b. Trowel machine
    c. Pony trowel
    d. Hand-held power trowel
    e. Riding trowel machine

12. Answer should include any three of the following.

    a. To spray form oil on concrete forms
    b. To spray curing compounds on finished concrete
    c. To spray monomolecular film on fresh concrete to reduce rapid evaporation
    d. To mist or fog finished concrete with water until suitable curing can take place

13. a. Gasoline-powered sprayer
    b. Hand-held tank sprayer
    c. Electric-powered sprayer

ANSWERS TO TEST

14. Answer should include any three of the following.

    a. To cut control joints in concrete
    b. To cut dummy joints in concrete
    c. To cut out sections of concrete for replacement
    d. To make cuts when demolishing concrete structures or slabs

15. a. Heavy-duty floor-type power saw
    b. Portable gasoline-powered saw
    c. Medium-duty floor-type power saw
    d. Portable electric-powered saw

16. a. 2, 3
    b. 6
    c. 1
    d. 7
    e. 4, 5

17. a. Commercial-type floor grinder
    b. Ceiling grinder
    c. Hand-held electric-powered grinder
    d. Portable, vibrator-type, gasoline-powered grinder
    e. Edge-and-base grinder
    f. Portable, flexible-hose, direct-drive, electric-powered grinder
    g. Trowel machine with grinder head

18. Evaluated to the satisfaction of the instructor.

19. Performance skills evaluated to the satisfaction of the instructor.

MISCELLANEOUS EQUIPMENT
UNIT IV

UNIT OBJECTIVE

After completing this unit, the student should be able to identify and state rules for the safe use of equipment for mixing concrete, for transporting and placing fresh concrete, for working with hardened concrete, miscellaneous concrete equipment, types of scaffolds and ladders, hoisting and lifting equipment, and types of rigging and other devices used for handling panels. The student should also be able to give hand signals for rigging and maneuvering operations and for forklift operations. The student will show this ability by completing job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Select correct definitions of terms associated with concrete equipment.
2. State general safety rules pertaining to concrete equipment use.
3. Label equipment used for mixing concrete.
4. Identify equipment used for transporting and placing fresh concrete.
5. Label equipment used for working with hardened concrete.
6. Label miscellaneous concrete equipment.
7. Match terms and definitions associated with scaffolds and ladders.
8. State safety rules pertaining to scaffolds.
9. Identify types of scaffolds.
10. Identify parts of prefabricated rolling scaffolding.
11. State safety rules pertaining to ladders.
12. State the safety rule for correct ladder placement.
13. Label types of portable ladders.
14. Match terms and definitions associated with rigging.
15. State safety rules pertaining to rigging.
16. Label hoisting and lifting equipment.

OBJECTIVE SHEET

17. Identify types of rigging and other devices used for handling panels.
18. State safety rules pertaining to giving hand signals.
19. Distinguish among hand signals used in rigging and maneuvering operations.
20. Label hand signals used in forklift operations.
21. Demonstrate the ability to
    a. Set up a section of prefabricated rolling scaffolding.
    b. Rig and handle an extra-long load.
    c. Rig and handle a load to be rotated.
    d. Rig and handle a noncentered load.

MISCELLANEOUS EQUIPMENT
UNIT IV

SUGGESTED ACTIVITIES

I. Unit contents

- A. Objective sheet
- B. Suggested activities
  - 1. Supplements
    - a. Supplement #1 — Determining Safe Working Capacities for Vertical and Sling Lifts
    - b. Supplement #2 — Miscellaneous Equipment Crossword Puzzle
  - 2. Transparency masters
    - a. TM #1 — Ladder Safety
    - b. TM #2 — Ladder Danger
    - c. TM #3 — Minimum Ladder Lengths for Various Working Heights
    - d. TM #4 — Formula for Calculating Sling Stress
    - e. TM #5 — Load Factors for Various Sling Angles
    - f. TM #6 — Formula for Calculating Critical Angle
- C. Information sheet
- D. Assignment sheets
  - 1. Assignment Sheet #1 — Perform Safety Inspections on Various Types of Ladders
  - 2. Assignment Sheet #2 — Distinguish Among Hand Signals Used in Rigging and Maneuvering Operations and in Forklift Operations
- E. Answers to assignment sheets
- F. Job sheets
  - 1. Job Sheet #1 — Set Up a Section of Prefabricated Rolling Scaffolding
  - 2. Job Sheet #2 — Rig and Handle an Extra-Long Load
  - 3. Job Sheet #3 — Rig and Handle a Load to Be Rotated
  - 4. Job Sheet #4 — Rig and Handle a Noncentered Load

SUGGESTED ACTIVITIES

G. Test

H. Answers to test

II. Instructor's guide

A. Review unit and plan presentation.

(NOTE: Be sure to review the three job sheets dealing with rigging and handling loads, and carefully plan their proper presentation for your students. The main purpose of these job sheets is to give your students practice in placing rigging in the proper position to facilitate hoisting and in giving proper hand signals to maneuver these loads. Students are not given enough information in this unit to be able to select the proper hoisting equipment or rigging needed for loads. These aspects of the job-sheet tasks have been left to the instructor, as they would be left to the supervisor on the job. If you wish to teach selection of proper rigging equipment in relation with this unit, you will need to supplement the unit with additional information such as that given in Supplement #1, Determining Safe Working Capacities for Vertical and Sling Lifts, and in Transparencies #4 through #6.)

B. Arrange for field trips to construction sites where the equipment discussed in this unit will be in operation.

C. Obtain materials to supplement unit.

1. Photos or drawings of concrete equipment

2. Ladders for students to inspect for Assignment Sheet #1

3. Slide/tape programs

   a. *Scaffold Safety*, Operative Plasters' and Cement Masons' International Association, n.d. Available from the Operative Plasterer's and Cement Masons' International Association, 1125 Seventeenth Street, N.W., Washington, D.C. 20036.

   b. *Ladder Safety*, Operative Plasterers' and Cement Masons' International Association, n.d. Available from the Operative Plasterers' and Cement Masons' International Association, 1125 Seventeenth Street, N.W., Washington, D.C. 20036.

4. Equipment and materials for completion of job-sheet procedures

5. Prefabricated scaffolding and swing-scaffolding components

6. Transparency masters and competency profiles

   (NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

SUGGESTED ACTIVITIES

D. Introduce unit.

SUGGESTION:

- Emphasize the importance of the students' becoming familiar with the safe and proper use of all the equipment discussed in this unit. Explain that, as a rule, this equipment is furnished by the contractor or the employer; however, each piece of this equipment is considered to be a tool of the trade that all concrete masons are expected to be able to work with and use safely.

E. Provide students with information, assignment, and job sheets.

F. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with concrete equipment.

   SUGGESTIONS:

   - Point out the importance of defining terms for common understanding.
   - Show examples or illustrations of as many of the terms as is practical.

2. Use Information Sheet, Sections II through VI, to discuss safety rules pertaining to concrete equipment use and the various types of equipment used in working with concrete.

   SUGGESTIONS:

   - Have students review Unit V, Section A, "Safety and Basic First Aid."
   - Discuss the specific uses of each piece of equipment illustrated in these sections of the information sheet.
   - Display photos or drawings of the various kinds of concrete equipment in these sections of the information sheet, and then have students play a game in which they describe the use of each piece of equipment.
   - Take students on a field trip to a large construction site to let them see what kinds of concrete equipment are being used by the concrete masons and how the masons are using them. Have each student list each piece of equipment he or she observes in use, and later, have a contest to see which student listed the most equipment.

3. Use Information Sheet, Section VII, to discuss terms and definitions associated with scaffolds and ladders.

   SUGGESTIONS:

   - Point out the importance of defining terms for common understanding.
   - Show examples or illustrations of as many of the terms as is practical.

SUGGESTED ACTIVITIES

4. Use Information Sheet, Sections VIII through X, to discuss safety rules pertaining to scaffolds, types of scaffolds, and parts of prefabricated rolling scaffolding.

SUGGESTIONS:

- Discuss with students the specific uses of each type of scaffolding illustrated in the information sheet.
- Discuss particular safety rules pertaining to each type of scaffolding.
- Take students to visit a large construction job where scaffolds are in use. Have each student make one list of the safe practices they observe on the site and another list of any safety rules they see being broken. Later in the classroom, discuss the possible consequences of breaking safety rules pertaining to scaffolding.
- Explain that prefabricated scaffolding is more versatile than other kinds of scaffolding and will therefore be the type they should become especially familiar with. Then, lay out the components of a unit of prefabricated rolling scaffolding, identify each part, and discuss the importance of each part as related to safety.
  - Explain the importance of guardrails, and emphasize that guardrails should *never* be removed from the scaffolding. Even when it is necessary to remove a guardrail temporarily to receive equipment or materials, only one section of the guardrail should be removed at a time, and the section should be replaced as soon as the maneuver has been completed.
  - Explain that if a section of guardrail has been removed to accept equipment or materials, it should always be replaced during breaks or at quitting time.
  - Explain the proper installation of toeboards, and explain to students that tools or materials should never be stacked higher than the height of the toeboards so that tools or materials cannot be kicked or knocked off the platform.
  - Explain that scaffold braces are *never* to be used as an access to the platform. Ladders or other special attachments should be used to provide access to the platform.
- Demonstrate the procedures in Job Sheet #1, "Set Up a Section of Prefabricated Rolling Scaffolding." Demonstrate both the individual and the team-of-two method of assembling the scaffolding.
- Have students complete Job Sheet #1.
- Explain that students should never *use* swing scaffolding until they have been thoroughly checked out on them by their supervisor. Emphasize how dangerous swing scaffolding can be unless they are used correctly. Assemble a swing scaffold, and then raise the scaffold 12 to 15 inches off the ground. Demonstrate the results if the scaffold is not tied off properly, and then demonstrate how to tie off a swing scaffold properly using fiber rope.

SUGGESTED ACTIVITIES

- Take students on a field trip to a construction site where swing scaffolds are being used. Point out types of attachments, such as roof or cornice hooks, parapet clamps, and counterweight outriggers. Explain the purposes of these different types of attachments.

5. Use Information Sheet, Sections XI through XIII, to discuss safety rules pertaining to ladders, the safety rule for correct ladder placement, and the types of portable ladders.

   SUGGESTIONS:

   - Visit a construction site and have students interview concrete masons on the safety rules they use in relation to ladders. Later, have students list on the chalkboard in the classroom any additional ladder-saftey rules they learned on the job.

   - Discuss with students the specific uses of the portable ladders illustrated in the information sheet. Use Transparencies #1 through #3 to expand your discussion.

     (NOTE: Also, at this point, you may want to discuss job-built ladders, although they are not covered in this unit.)

   - Have students complete Assignment Sheet #1, "Perform Safety Inspections on Various Types of Ladders."

6. Use Information Sheet, Section XIV, to discuss terms and definitions associated with rigging.

   SUGGESTIONS:

   - Point out the importance of defining terms for common understanding.

   - Show examples or illustrations of as many of the terms as is practical.

7. Use Information Sheet, Sections XV through XX, to discuss safety rules pertaining to rigging, types of hoisting and lifting equipment, types of rigging and other devices used for handling panels, safety rules pertaining to giving hand signals, and hand signals used in rigging and maneuvering operations and in forklift operations.

   SUGGESTIONS:

   - Explain that concrete masons may be involved in rigging and hoisting operations when setting tilt-up walls and precast panels and when hoisting concrete and other materials.

   - Emphasize how dangerous rigging and hoisting operations can be when they are done improperly.

   - Have students learn the hand signals they will be expected to use on the job, and then have them pair off and practice giving and receiving hand signals.

SUGGESTED ACTIVITIES

- Have students complete Assignment Sheet #2, "Distinguish Among Hand Signals Used in Rigging and Maneuvering Operations and in Forklift Operations."
- Demonstrate the procedures in Job Sheets #2 through #4, and remain available to observe and correct students' procedures as they complete these job sheets.

G. Have students complete Supplement #2, "Miscellaneous Equipment Crossword Puzzle."

H. Give test.

I. Critique test and discuss in class.

J. Reteach and retest as necessary.

K. Complete appropriate section of competency profiles.

III. Unit references

A. Hendrix, Laborn J., "Bud". *Bricklaying Curriculum*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1984.

B. Hendrix, Laborn J., "Bud". *Cement Masons Curriculum*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1975.

C. Hendrix, Laborn J., "Bud". *Fundamentals of Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1985.

D. *OP and CMIA Safety and Health Training Program*. Washington, D.C.: Operative Plasters' and Cement Masons' International Association of the United States and Canada, n.d.

E. *Schwing America, Inc., Technical Data Brochure*. St. Paul, Minnesota: Schwing America, Inc., n.d.

SUGGESTED ACTIVITIES

SUPPLEMENT #1 — DETERMINING SAFE WORKING CAPACITIES FOR VERTICAL AND SLING LIFTS

Concrete masons must be proficient at determining the safe working capacities of the wire ropes they will be working with in rigging for hoisting procedures. If safe working capacities of wire rope are not determined, accidents may occur causing wasted materials and serious injury to workers.

The maximum strength of a wire rope is called the "breaking strength" of the rope. You can establish the breaking strength of a wire rope by using standard tables commonly supplied by the industry. However, before a load is actually applied to a wire rope, you must determine the maximum load that can be lifted *safely* by a wire rope with a certain breaking strength. This safety factor is called the "safe working capacity" of the wire rope, or the SWC.

You can determine the SWC of a wire rope by using a standard table, or you can use the rule-of-thumb formula

$$\text{SWC} = 8\,D^2,$$

where SWC is the safe working capacity of the rope and D is the diameter of the rope.

You should be aware that the SWC calculated by using the above formula may differ from the SWC given in a standard table. The table is more accurate and should be used whenever possible.

You should also be aware that the SWC determined through one of the two methods described above is reliable only when you are determining the SWC for a wire rope to be used in a vertical lift. When a wire-rope sling is to be used for lifting, the angle of the sling legs must be considered as well as the SWC of the wire rope.

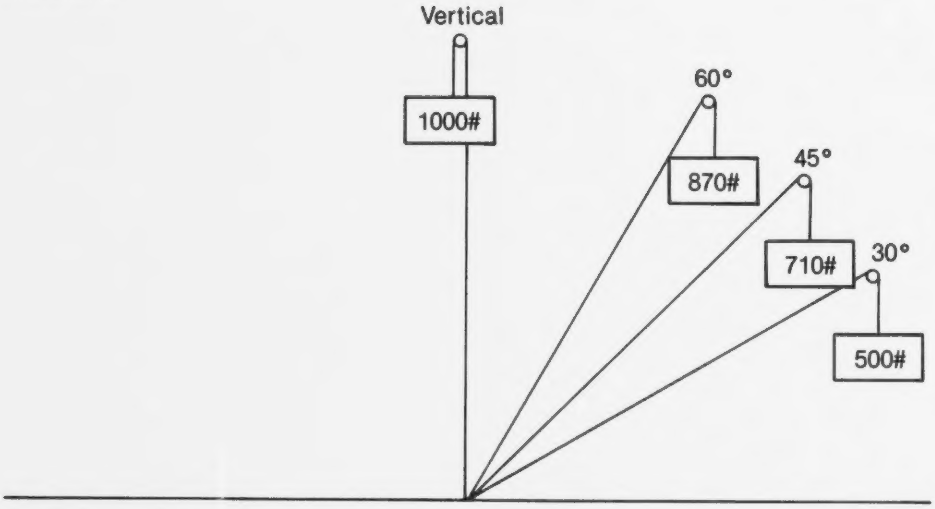
In considering the relationship between the sling-leg angle and the sling's SWC, keep the following rules in mind.

1. Decreasing the sling-leg angle increases the stress on the sling (see Figure A).
2. Increasing the stress on the sling decreases the wire rope's SWC.

For example, when a sling leg is at a 60-degree angle, the sling's SWC is only 87 percent of that of a vertical leg. At a 45-degree angle, the sling's SWC is 71 percent of that of a vertical leg, while at a 30-degree angle, the SWC is 50 percent of that of a vertical leg. See Figure A.

SUPPLEMENT #1

FIGURE A



Therefore, an additional factor in computing the SWC of a wire rope to be used in a sling lift is the stress that will be put on a single sling leg. This stress factor can be calculated by using the formula

$$S = \frac{W}{H} \times \frac{L}{N},$$

where S is the amount of sling stress, W is the weight of the load, H is the height or vertical distance measured from the boom hook to the top of the load (see Figure B), L is the length of a single sling leg, and N is the number of sling legs.

For example, if you need to determine the stress factor on the 6-foot-long single leg of a two-legged sling to be used to lift a load weighing 10 tons that will have a vertical distance of 4 feet, then

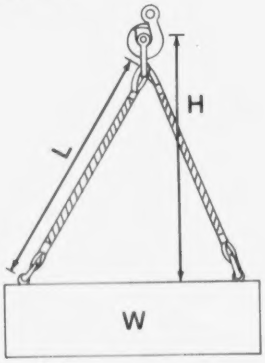
$$S = \frac{W}{H} \times \frac{L}{N}, \text{ or}$$

$$S = \frac{10}{4} \times \frac{6}{2}$$

$$S = \frac{60}{8}$$

$$S = 7\ 1/2 \text{ tons.}$$

FIGURE B



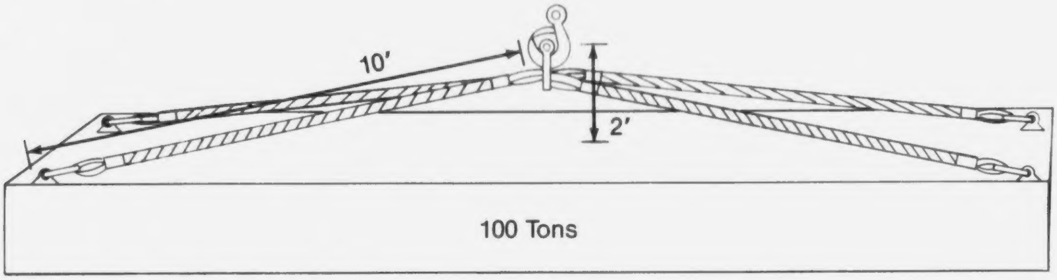
SUPPLEMENT #1

Once you have determined the sling stress factor, you must be sure that the safe working capacity of the wire rope used in the sling is equal to—or greater than—the stress to be placed on a single sling leg.

Some hoisting operations accomplished by concrete masons will involve using a sling lift; therefore, it is especially important that you be able to compute sling stress. To give you practice in computing sling stress, complete the following exercises.

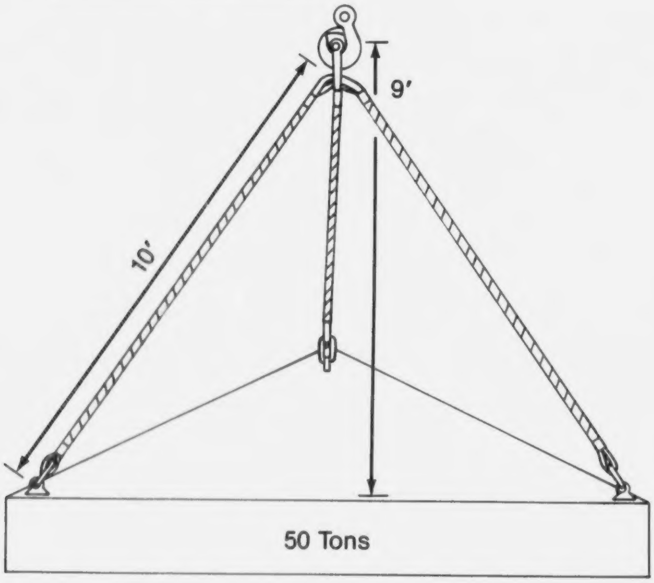
Using the formula for sling stress, compute sling stress. Show your work in the spaces provided, and write the correct answers on the blanks provided.

A. Sling stress = ____________________

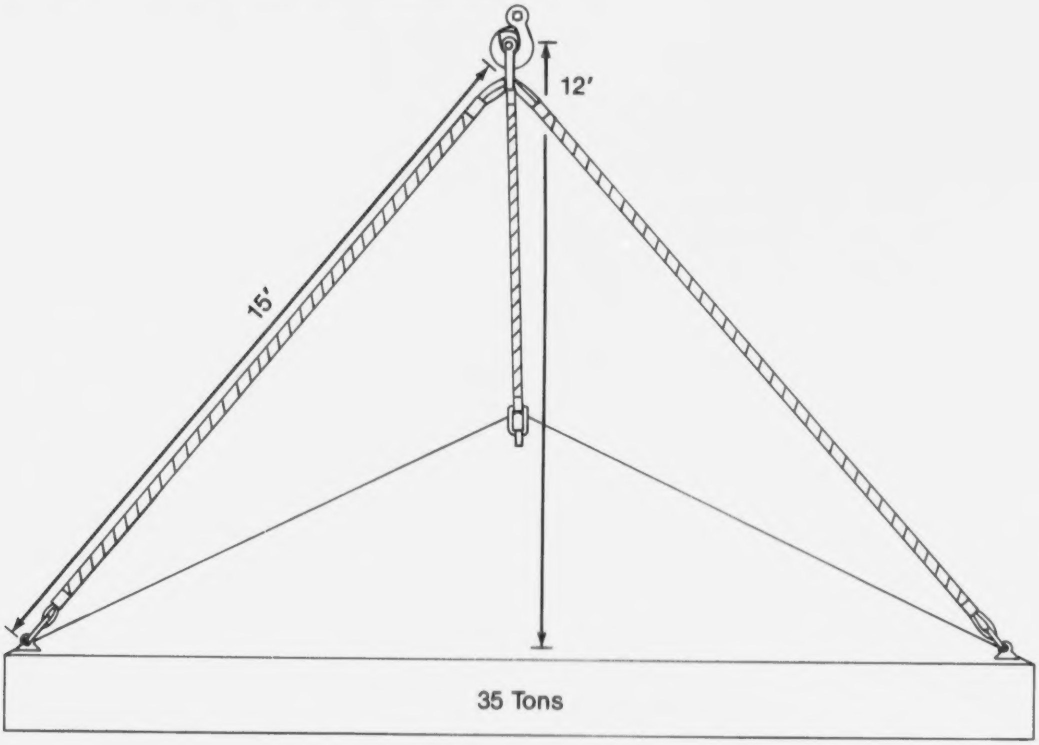


SUPPLEMENT #1

B. Sling stress = ____________________



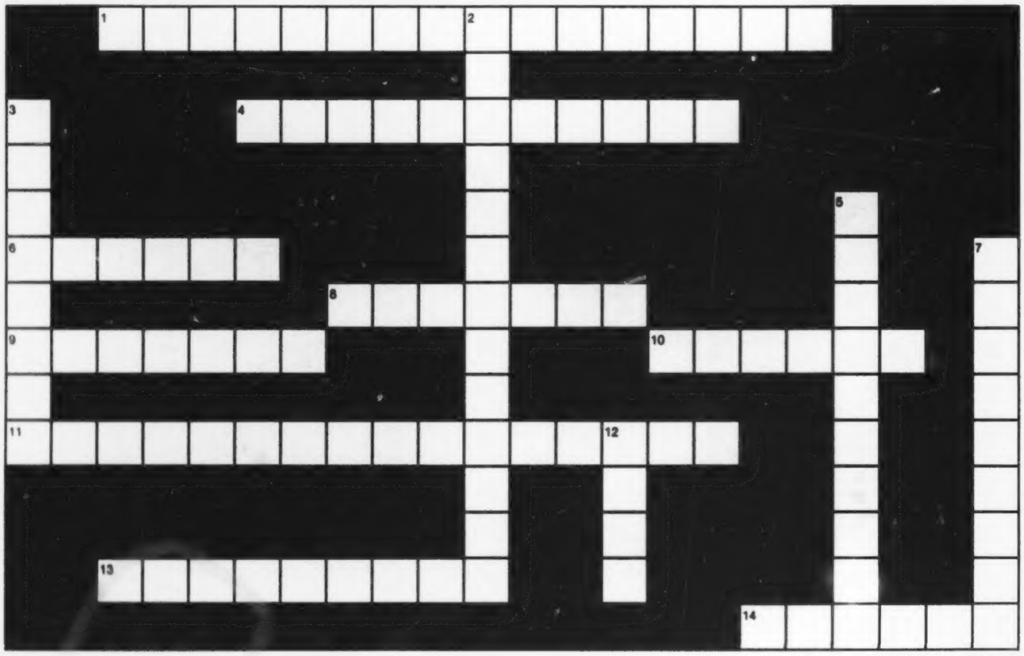
C. Sling stress = ____________________


12′
15′
35 Tons

SUGGESTED ACTIVITIES

SUPPLEMENT #2 — MISCELLANEOUS EQUIPMENT CROSSWORD PUZZLE

Review the information sheet, and then use the clues below to complete the following crossword puzzle.



ACROSS

1. Type of scaffold constructed on the job site (3 words)
4. Raising a concrete slab by pumping grout under the slab
6. Freedom from danger, risk, or injury
8. Line used to guide or steady load during hoisting
9. Structures for climbing up or down
10. Wheel mounted in a swivel frame and usually furnished with a brake
11. Another name for a swing-stage scaffold
13. Safety rails placed just above the platform on prefabricated rolling scaffolding
14. Pipe or tube through which concrete is deposited under water

DOWN

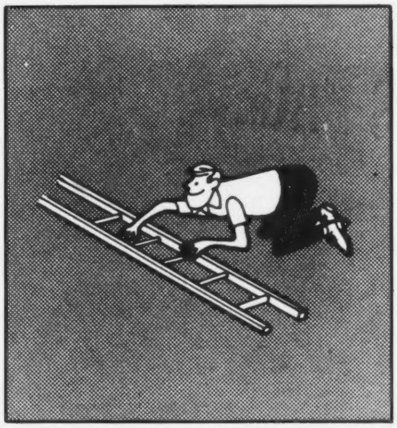
2. Angle-shaped devices manufactured to fasten on forms in pairs to support a platform for job-built scaffolding
3. Timber or timber assembly used to keep scaffold legs from sinking into the ground or to protect supporting surface from being damaged by scaffold legs
5. Nonslip device attached to bottom of ladder rails
7. Pneumatically applied concrete
12. Occupational Safety and Health Act (abbr.)

SUPPLEMENT #2

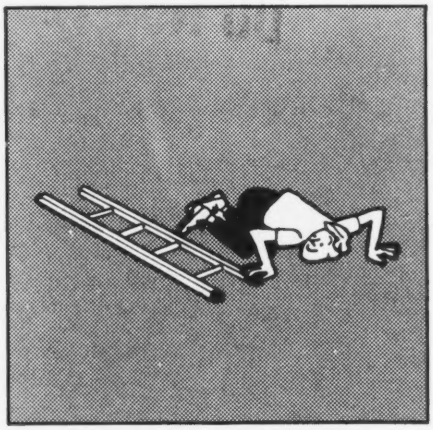
Solution to Puzzle

		1 J	O	B	B	U	I	L	T	2 S	C	A	F	F	O	L	D				
										C											
3 M					4 S	L	A	B	J	A	C	K	I	N	G						
U										F											
D										F								5 S			
6 S	A	F	E	T	Y					O								A			7 S
I							8 T	A	G	L	I	N	E					F			H
9 L	A	D	D	E	R	S				D				10 C	A	S	T	E	R		O
L										J								T			T
11 S	W	I	N	G	I	N	G	S	C	A	F	F	12 O	L	D			Y			C
										C			S					S			R
										K			H					H			E
		13 T	O	E	B	O	A	R	D	S			A					O			T
																14 T	R	E	M	I	E

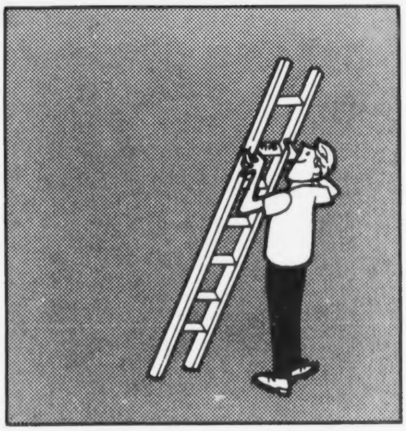
Ladder Safety



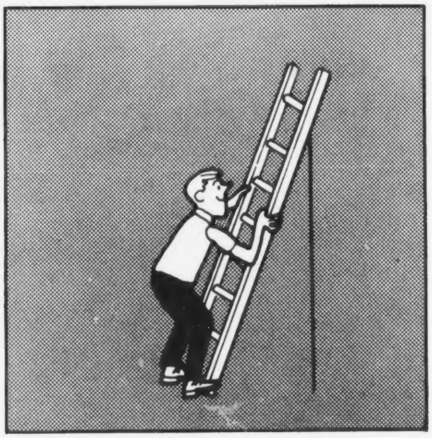
Check Condition



Check Safety Shoes



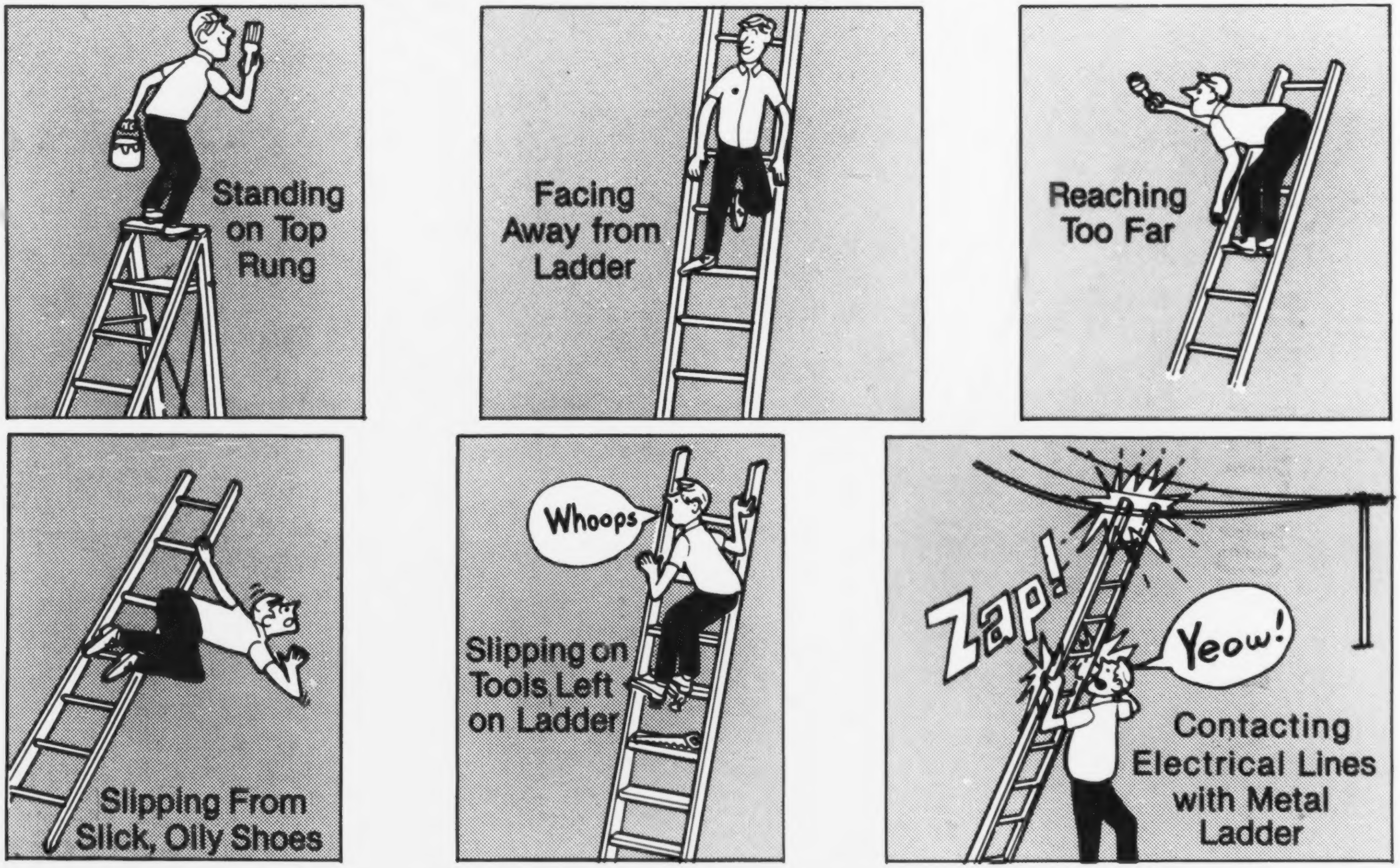
Check Load Limit



Place at Comfortable Stance

Adapted with permission of American Association for Vocational Instructional Materials, Athens, Georgia, from *Developing Shop Safety Skills* by Clinton O. Jacobs and J. Howard Turner, 1981.

Ladder Danger


Standing on Top Rung
Facing Away from Ladder
Reaching Too Far
Slipping From Slick, Oily Shoes
Whoops
Slipping on Tools Left on Ladder
Zap!
Yeow!
Contacting Electrical Lines with Metal Ladder

Adapted with permission of American Association for Vocational Instructional Materials, Athens, Georgia, from *Developing Shop Safety Skills* by Clinton O. Jacobs and J. Howard Turner, 1981.

TM #2

FCCM - 203-D

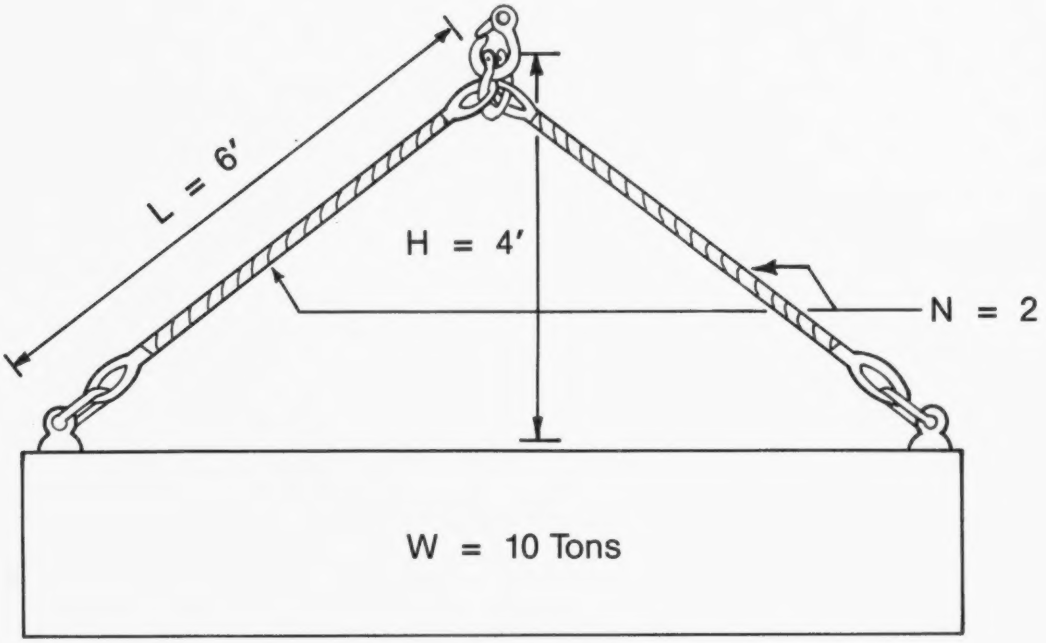
Minimum Ladder Lengths for Various Working Heights

Minimum ladder lengths for various working heights

Working height (feet)	Minimum ladder length (feet)
12	16
14	18
16	20
20	24
24	28
28	32
32	36
36	40*
38	44
44	50

*Most ladders over 38 feet long are made in three sections, and three-section ladders are required for working heights of 50 feet and over.

Formula for Calculating Sling Stress


L = 6'
H = 4'
N = 2
W = 10 Tons

$$S = \frac{W \times L}{H \times N}$$

$$S = \frac{10 \times 6}{4 \times 2}$$

$$S = \frac{60}{8}$$

$$S = 7\,{}^{1}\!/_{2}\ \text{Tons}$$

LOAD FACTORS FOR VARIOUS SLING ANGLES

Load factors for various sling angles

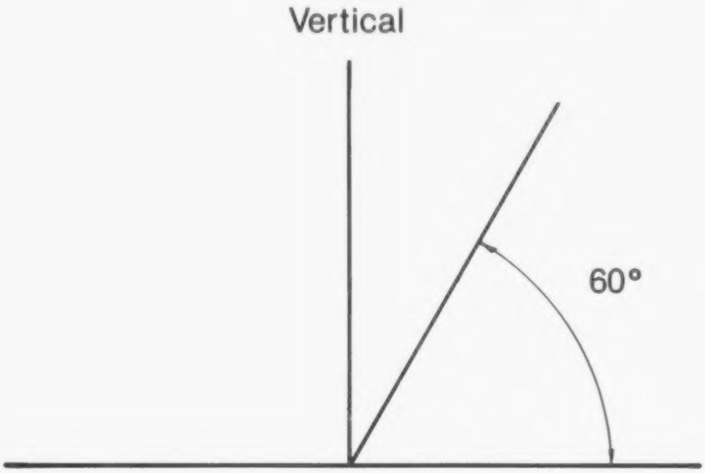
Sling angle	Load factor
0° (Vertical)	1.000
15°	1.035
20°	1.064
25°	1.104
30°	1.155
35°	1.221
40°	1.305
45°	1.414
50°	1.555
55°	1.742
60°	2.000

Formula for Calculating Critical Angle

The formula for calculating critical angle* is

$$CA = \frac{60^\circ}{N},$$

when CA is the critical angle and N is the number of legs.



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*"Critical angle" is the sling angle that exists when the tension in the sling leg equals the weight of the load.

MISCELLANEOUS EQUIPMENT
UNIT IV

INFORMATION SHEET

I. Terms and definitions associated with concrete equipment

  A. Tremie — Pipe or tube with a top in the form of a hopper; used for depositing concrete under water

  B. Elephant trunk — Flexible drop chute through which concrete is deposited into deep forms

  C. Vibrator — Machine used to agitate fresh concrete in order to consolidate concrete and to eliminate voids, including entrapped air

  D. Scabble — To work or shape roughly

  E. Sandblast — To remove concrete surface with a stream of sand ejected from a nozzle at high speed by compressed air; often used to clean horizontal construction joints or to expose aggregate

  F. Slab jack — To raise a concrete slab by pumping grout under the slab

  G. Shotcrete (gunite) — Pneumatically applied concrete; process where cement mixtures are projected at high speed by compressed air onto a surface

  H. Lift-slab — Method of concrete construction in which floor and roof slabs on or at ground level are hoisted into position by jacking

II. General safety rules pertaining to concrete equipment use

  A. *Do not* remove safety devices from equipment

  B. Check condition of all equipment before using

  C. Always mark damaged equipment and report any equipment damage to your instructor or supervisor

  D. Exercise extreme caution when moving equipment

  E. Exercise extreme caution when using hoisting equipment

  F. *Do not* attempt to operate equipment before being instructed on its proper use

  G. Wear safety clothing and equipment as required by the job being done

  H. Be sure there is proper ventilation before operating gasoline-powered equipment in an enclosed area

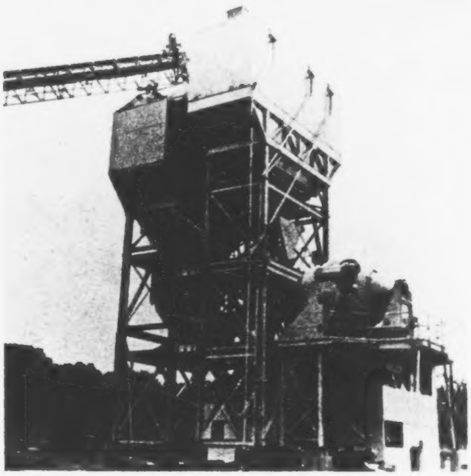
  I. Keep a fire extinguisher handy when operating and filling gasoline-powered equipment

INFORMATION SHEET

III. Equipment used for mixing concrete (Figures 1-3)

A. Concrete batch plant

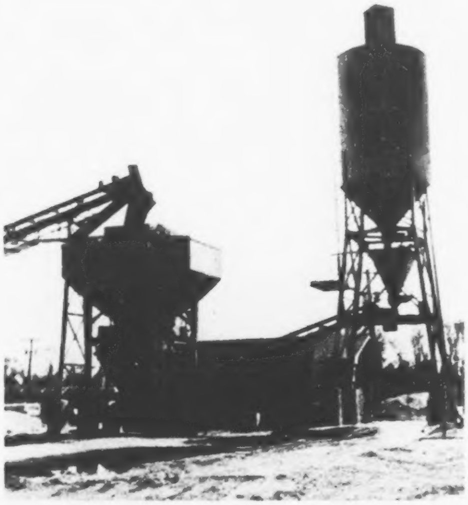
FIGURE 1



Courtesy of Rexworks, Oklahoma City, Oklahoma.

B. Mobile (transit) concrete plant

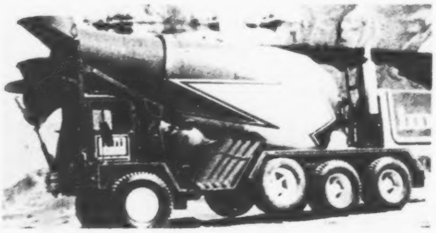
FIGURE 2



Courtesy of Rexworks,
Oklahoma City, Oklahoma.

C. Transit-mix concrete truck

FIGURE 3



Courtesy of IMI, Irving Materials,
Inc., Greenfield, Indiana.

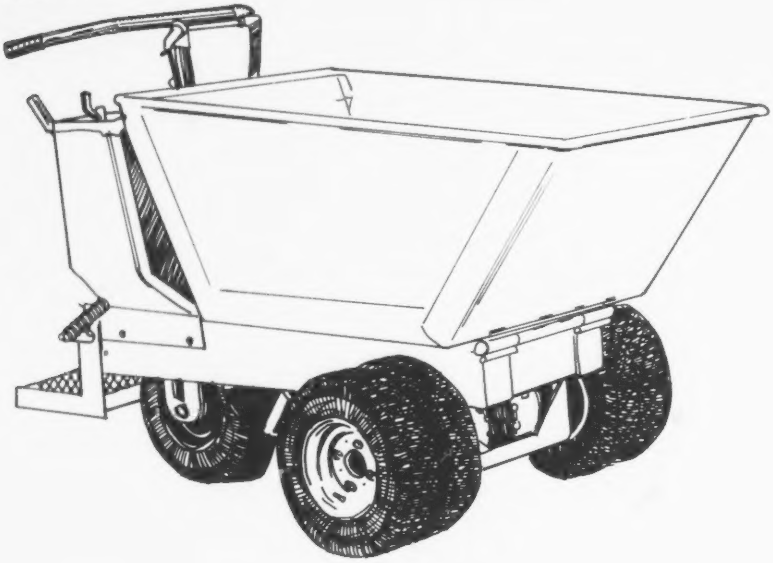
INFORMATION SHEET

IV. Equipment used for transporting and placing fresh concrete (Figures 4-25)

A. **Buggies and wheelbarrows**

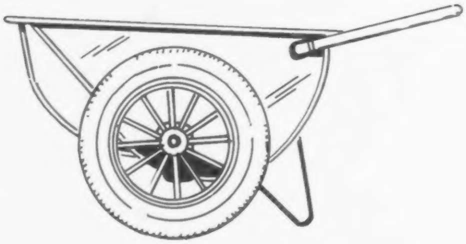
1. Power buggy

FIGURE 4



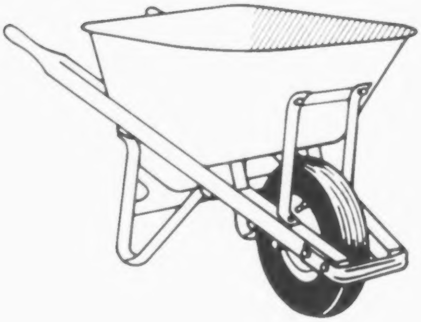
2. Hand buggy

FIGURE 5



3. Wheelbarrow

FIGURE 6

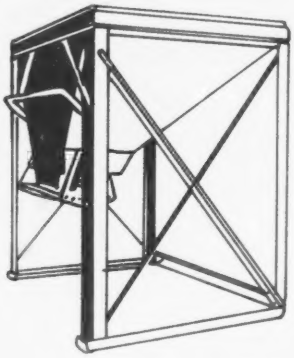


INFORMATION SHEET

B. **Hoppers and chutes**

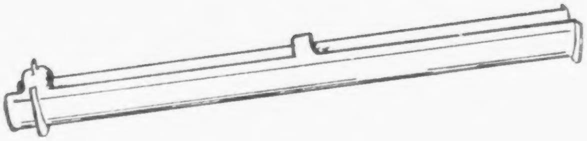
1. Concrete hopper

FIGURE 7



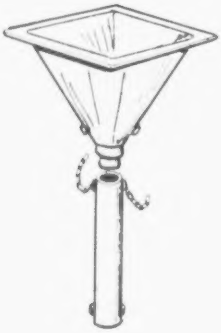
2. Concrete chute

FIGURE 8



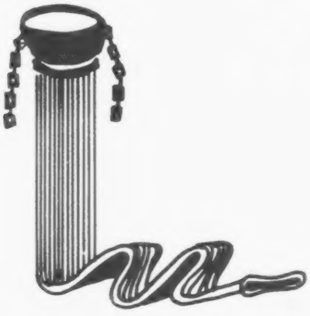
3. Tremie

FIGURE 9



4. Elephant trunk

FIGURE 10

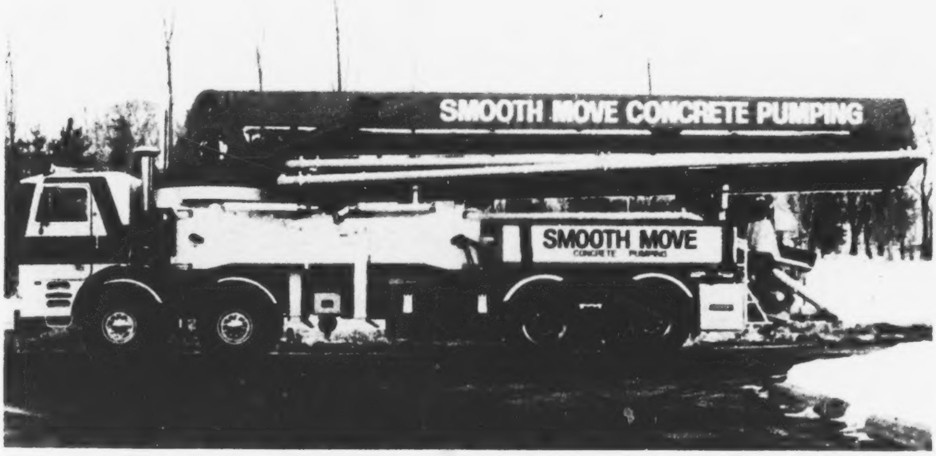


INFORMATION SHEET

C. **Pumps**

1. Mobile concrete pump (with placing boom)

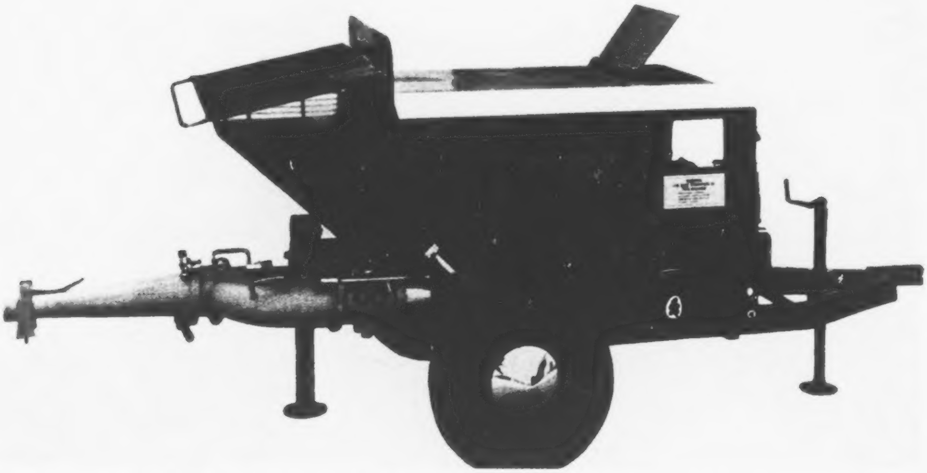
FIGURE 11


SMOOTH MOVE CONCRETE PUMPING
SMOOTH MOVE
CONCRETE PUMPING

Courtesy of Schwing America, Inc., White Bear, Minnesota.

2. Portable concrete pump

FIGURE 12



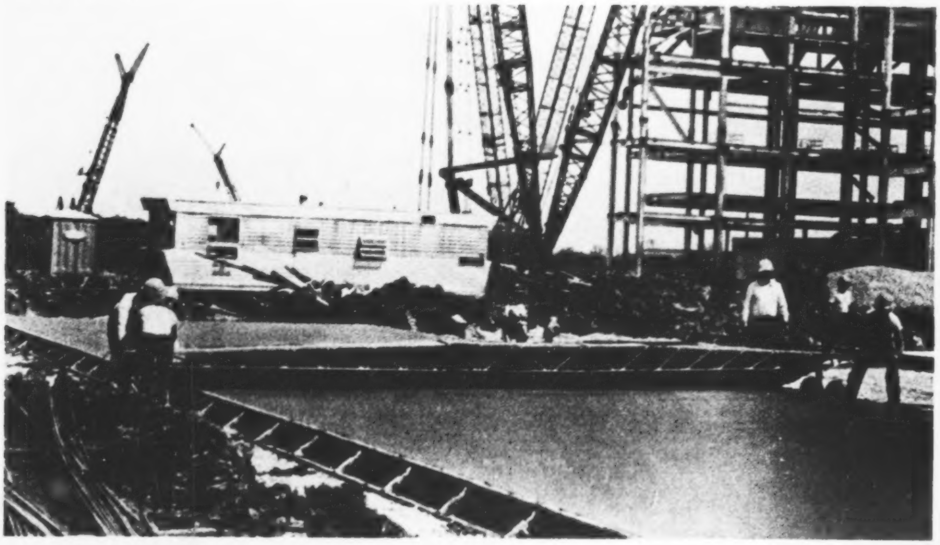
Courtesy of AIRPLACO, Air Placement Equipment Company, Inc., Cincinnati, Ohio.

INFORMATION SHEET

D. **Work bridges**

1. Standard work bridge

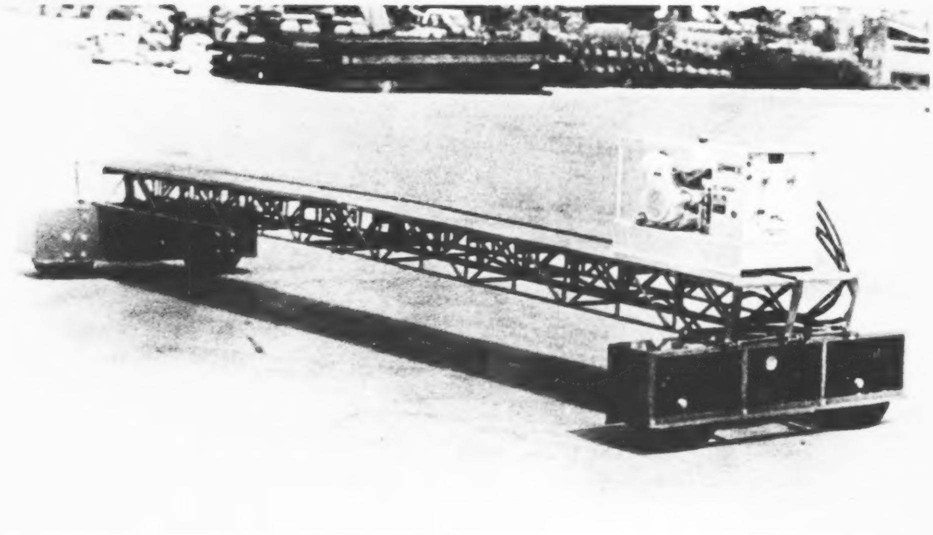
FIGURE 13



Courtesy of GOMACO Corporation, Ida Grove, Iowa.

2. Powered work bridge

FIGURE 14



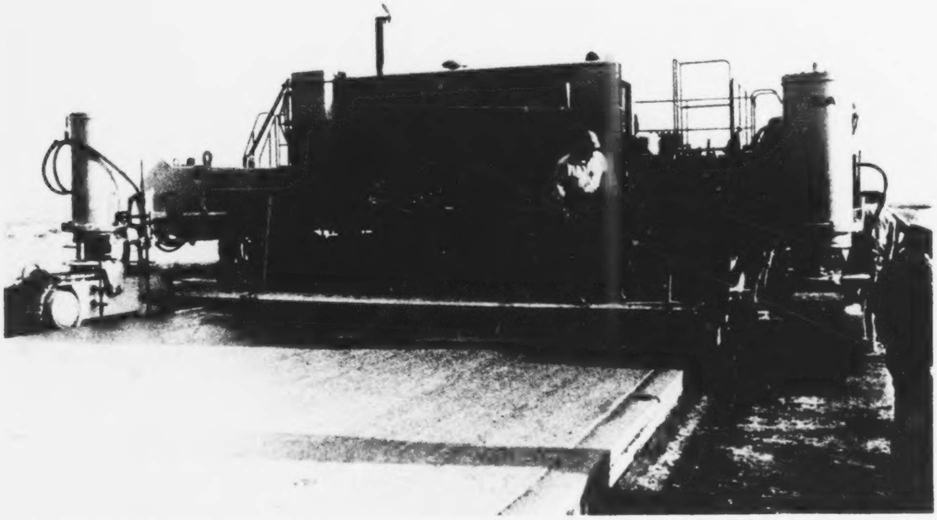
Courtesy of GOMACO Corporation, Ida Grove, Iowa.

INFORMATION SHEET

E. **Pavers**

1. Slip-form paver

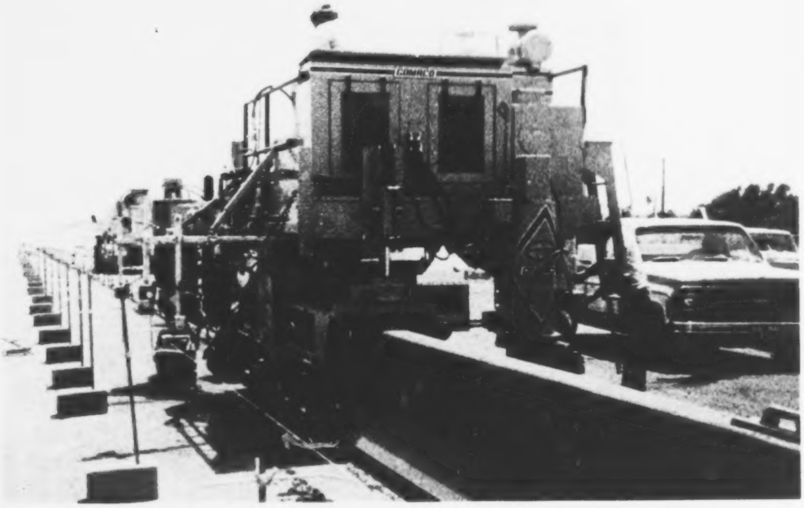
FIGURE 15



Courtesy of CMI, Oklahoma City, Oklahoma.

2. Curb-and-gutter slip-form paver (used to create a concrete barrier wall)

FIGURE 16

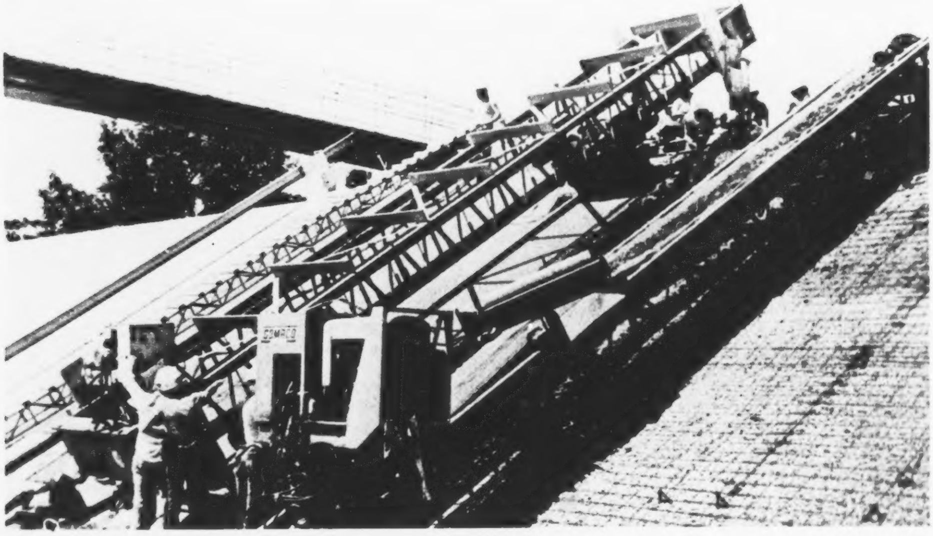


Courtesy of GOMACO Corporation, Ida Grove, Iowa.

INFORMATION SHEET

3. Slope paver (and work bridge and slope conveyor)

FIGURE 17

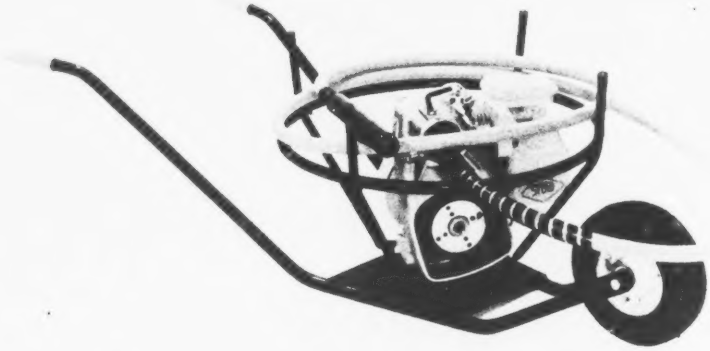


Courtesy of GOMACO Corporation, Ida Grove, Iowa.

F. **Electric vibrators**

1. Heavy-duty vibrator

FIGURE 18

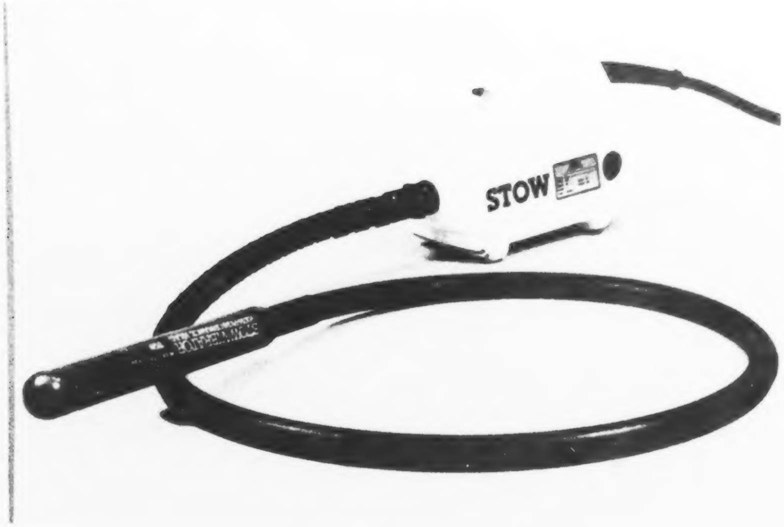


Courtesy of Stow Manufacturing Company, Binghamton, New York.

INFORMATION SHEET

2. Lightweight vibrator

FIGURE 19

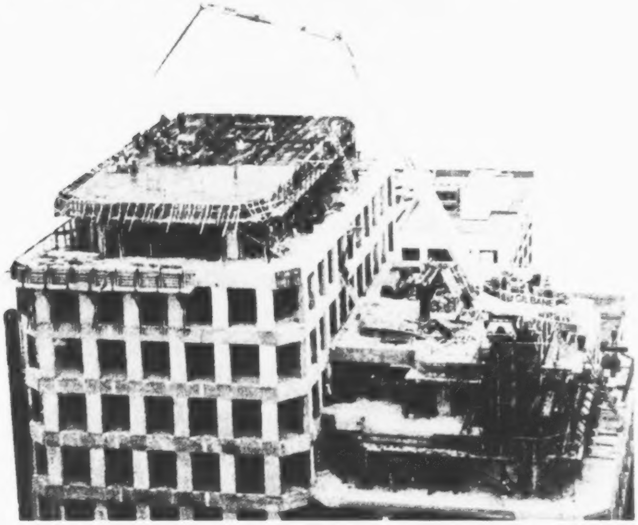


Courtesy of Stow Manufacturing Company, Binghamton, New York.

G. **Miscellaneous transporting and placing equipment**

1. Placing boom

FIGURE 20

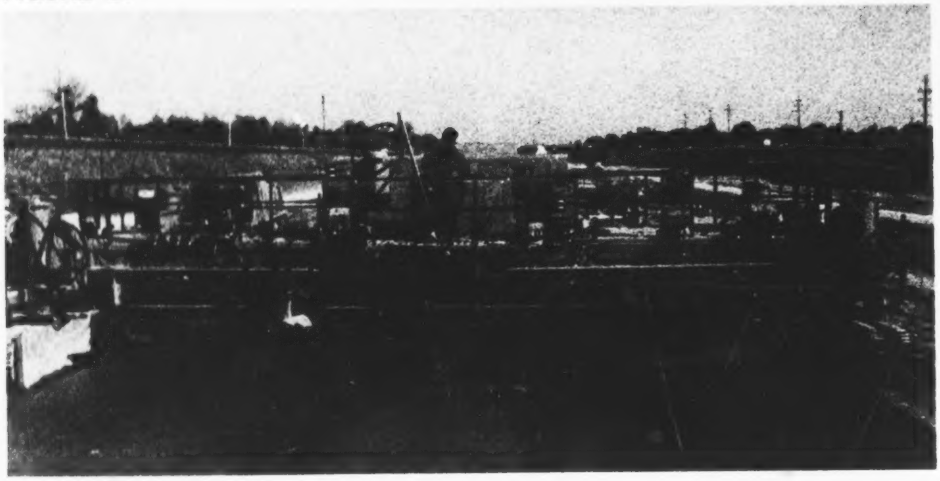


Courtesy of Schwing America, Inc., White Bear, Minnesota.

INFORMATION SHEET

2. Placer/spreader

FIGURE 21



Courtesy of CMI, Oklahoma City, Oklahoma.

3. Cableway

4. Tramway

FIGURE 22

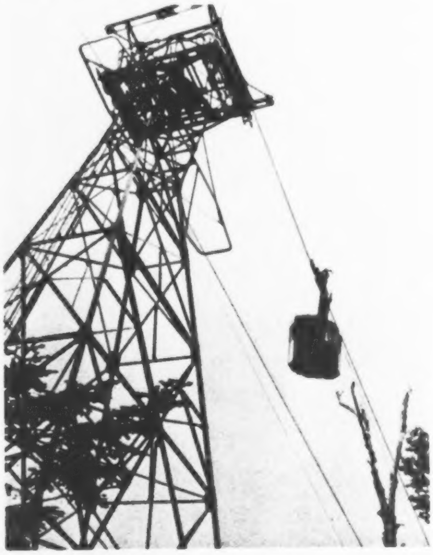
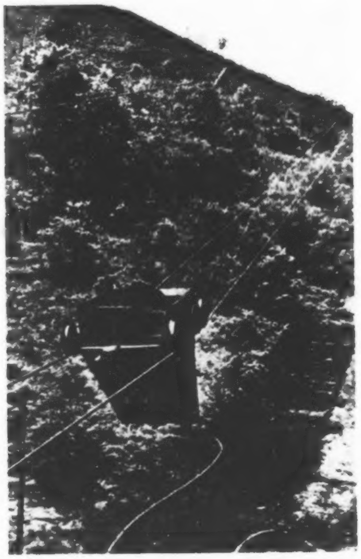


FIGURE 23

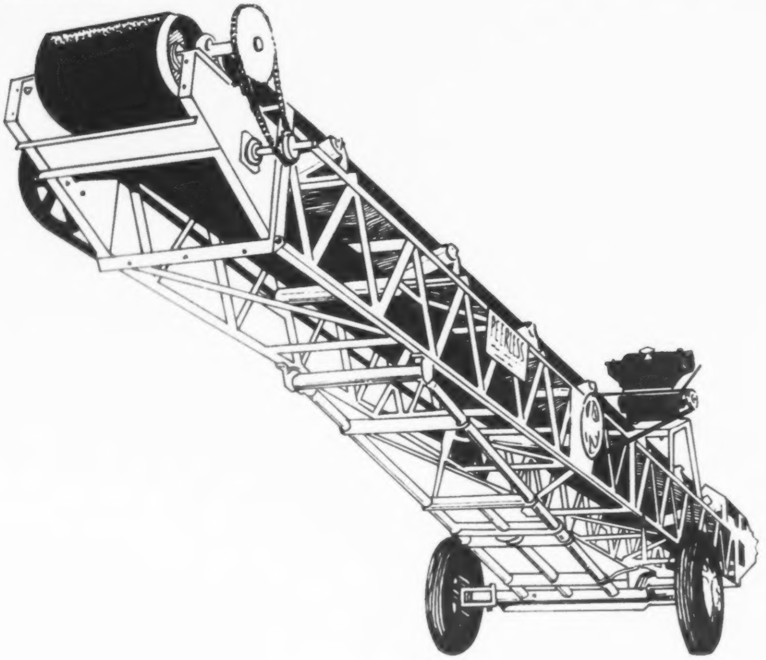


Figures 21 and 22 courtesy of American Steel and Wire Company, Cleveland, Ohio.

INFORMATION SHEET

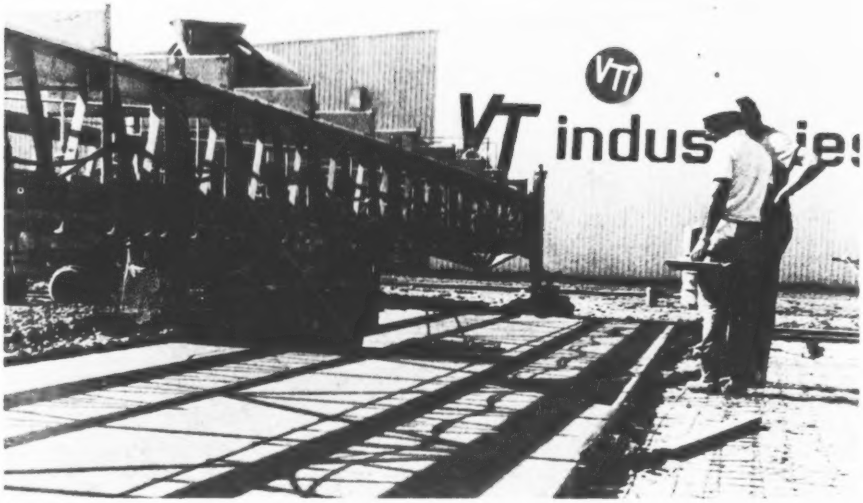
5. Conveyor

FIGURE 24



6. Finishing machine

FIGURE 25


VT industries

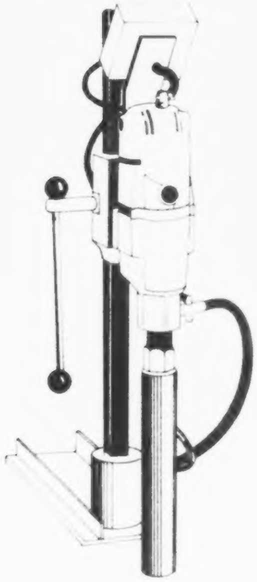
Courtesy of GOMACO Corporation, Ida Grove, Iowa.

INFORMATION SHEET

V. Equipment used for working with hardened concrete (Figures 26-32)

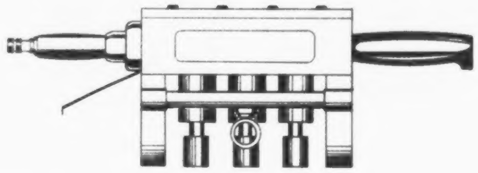
A. Core drill

FIGURE 26



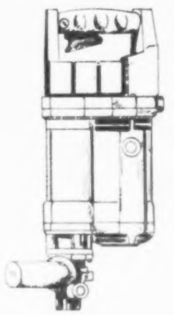
B. Scabbler

FIGURE 27



C. Electric hammer

FIGURE 28



D. Air compressor and air-powered hammers

FIGURE 29

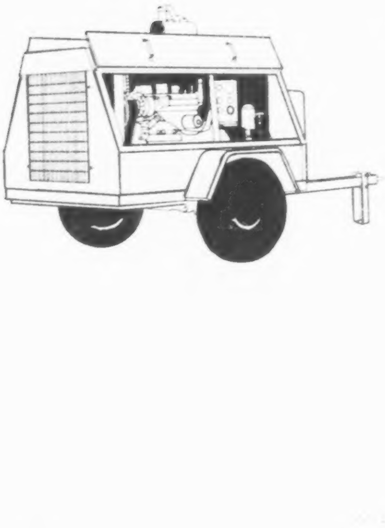


FIGURE 30

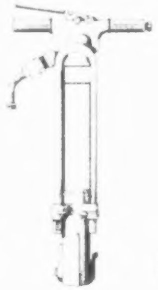


FIGURE 31

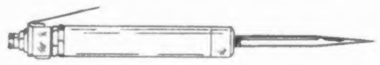
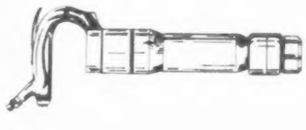


FIGURE 32

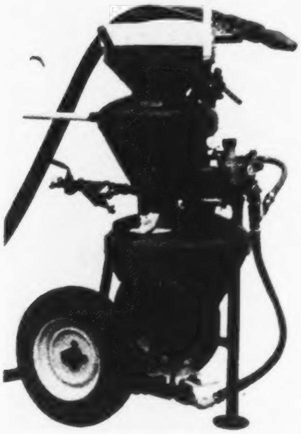


INFORMATION SHEET

VI. Miscellaneous concrete equipment (Figures 33-40)

A. Sandblasting equipment

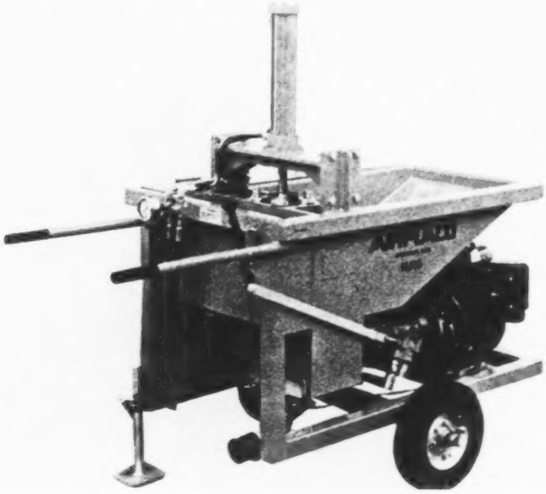
FIGURE 33



Courtesy of AIRPLACO, Air Placement Equipment Company, Inc., Cincinnati, Ohio.

B. Slab-jacking equipment (mud-jacking equipment)

FIGURE 34

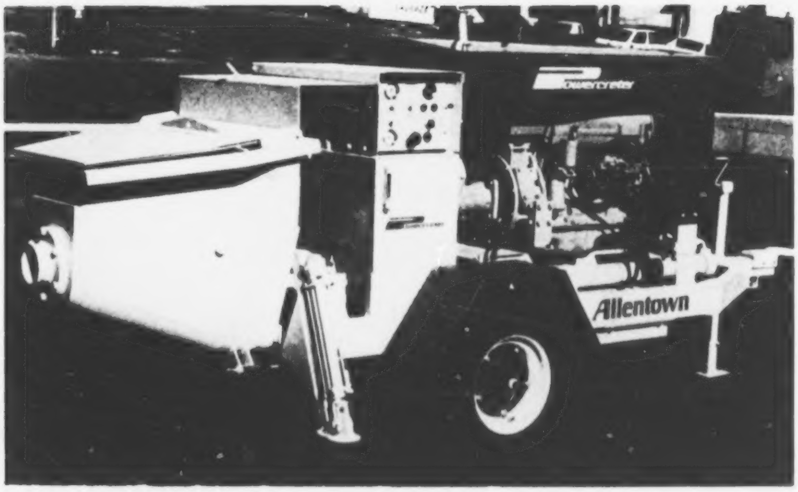


Courtesy of AIRPLACO, Air Placement Equipment Company, Inc., Cincinnati, Ohio.

INFORMATION SHEET

C. Shotcrete equipment

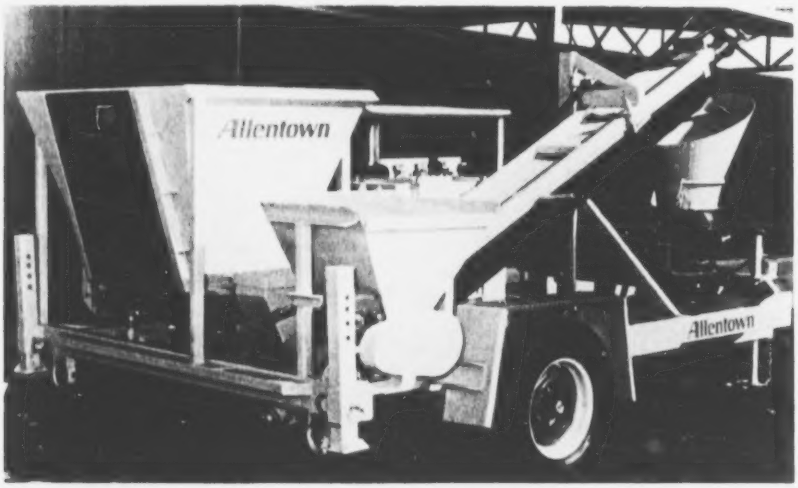
FIGURE 35


Powercreter
Allentown

Courtesy of Allentown Pneumatic Gun, Inc., Allentown, Pennsylvania.

D. Gunite machine

FIGURE 36

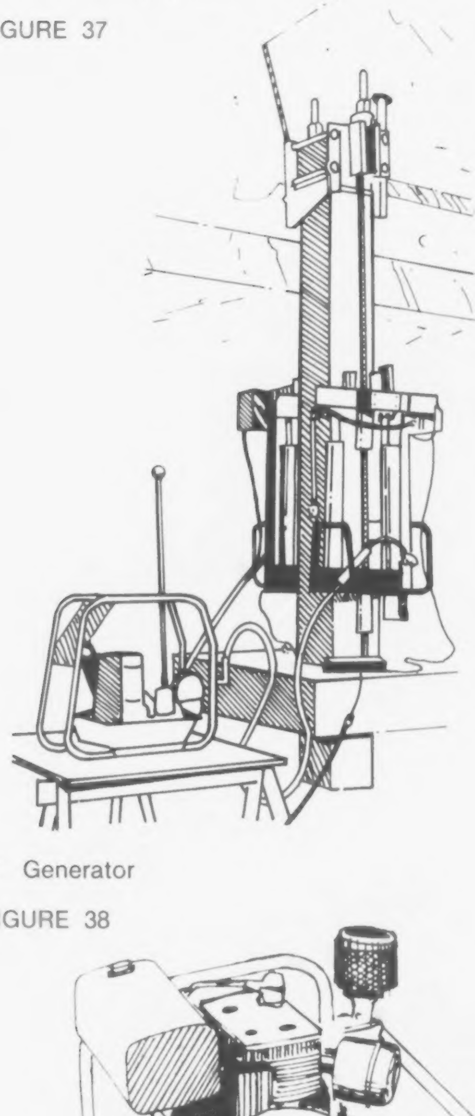

Allentown
Allentown

Courtesy of Allentown Pneumatic Gun, Inc., Allentown, Pennsylvania.

INFORMATION SHEET

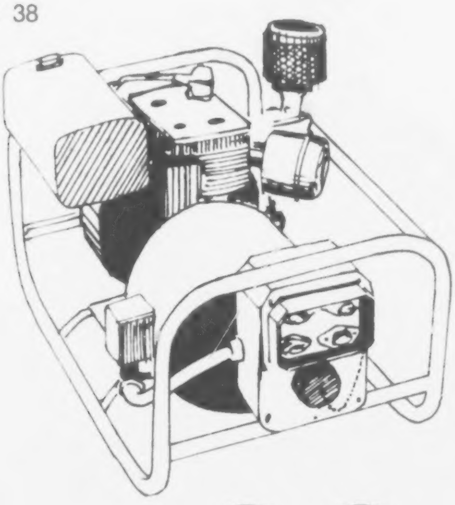
E. Lift-slab equipment

FIGURE 37



F. Generator

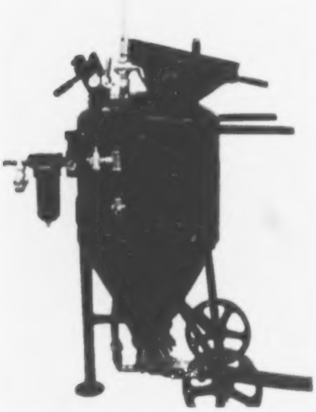
FIGURE 38



INFORMATION SHEET

G. Grouter/placer

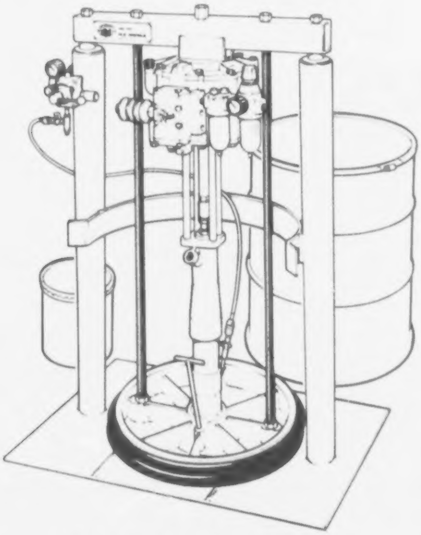
FIGURE 39



Courtesy of AIRPLACO, Air Placement Equipment Company, Inc., Cincinnati, Ohio.

H. Joint-sealing equipment

FIGURE 40



Courtesy of Pyles Division, Sealed Power Corporation, Wixom, Mississippi.

INFORMATION SHEET

VII. Terms and definitions associated with scaffolds and ladders

A. Caster — Wheel mounted in a swivel frame and usually furnished with a brake

B. Mudsill — Timber or timber assembly used to keep scaffold legs from sinking into the ground or to protect supporting surface from being damaged by scaffold legs

C. Guardrail — Safety rail used on platforms or scaffolds

D. Lifeline — Safety line attached to structure and used by workers to cling to if scaffold should fall

E. Occupational Safety and Health Act (OSHA) — Federal legislation adopted in 1970 to provide safe and healthy workplaces for employees

F. Prefabricated — Manufactured at a factory so that job-site construction consists mainly of assembling standardized parts

G. Job-built — Constructed at the job site

H. Safety shoe — Nonslip device attached to bottom of ladder rails

I. Fixed ladder — Ladder attached solidly to a structure; usually made of metal and used as a fire escape, roof access, or access to the exterior of tanks and silos

VIII. Safety rules pertaining to scaffolds

A. Check for electrical wires and deenergize any wires in the vicinity before erecting scaffold

B. Be sure casters are locked before ascending rolling scaffolds

C. *Do not* work on scaffolds during storms, high winds, or when scaffolds are covered with ice or snow

D. Tie off scaffolds every 25 feet when they are erected several sections high

E. *Do not* overload scaffolds

F. Be sure that scaffolds are equipped with toprail, midrail, and toeboard

G. Use safety belts, harness, and nets as required

H. *Do not* use bent, broken, or severely rusted scaffold parts

I. Be sure scaffolds are erected level

J. Be sure to use mudsills under scaffolds

INFORMATION SHEET

K. Be sure scaffold parts used fit the scaffold

L. When building wood scaffolds, be sure all wood is straight-grained and free of through-knots

M. *Do not* remove guardrails

N. *Never* attempt to move a rolling scaffold by yourself

O. Be sure lifelines on swinging scaffolds are attached to a structural member of the building and not to the scaffold or outrigger

P. Keep lifeline adjusted to proper height

Q. *Do not* use power swing scaffolds until you have received proper instructions

R. Familiarize yourself with local, state, and federal safety and health requirements, and be governed accordingly

S. Know and follow OSHA safety regulations when working on scaffolds

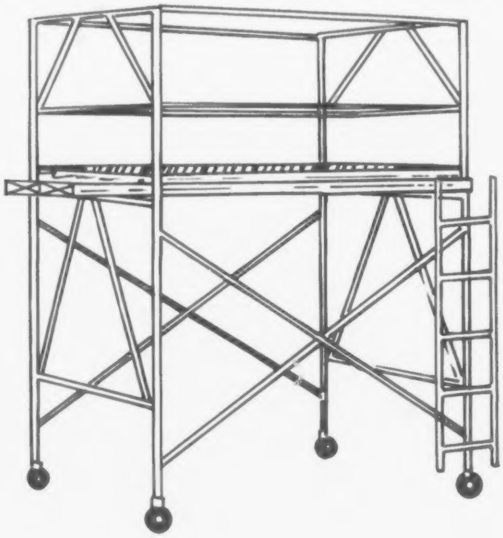
IX. Types of scaffolds (Figures 41-50)

(NOTE: Scaffolds may be made of wood, steel, or aluminum.)

A. Prefabricated scaffolding

1. Metal, rolling, prefabricated scaffolding

FIGURE 41



INFORMATION SHEET

FIGURE 42

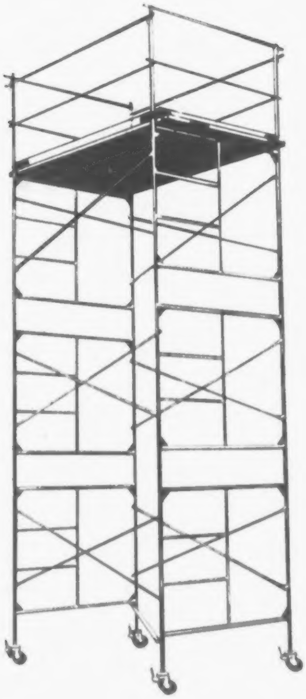
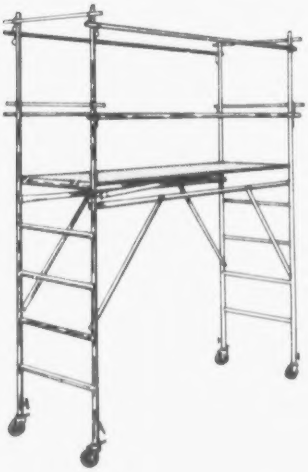


FIGURE 43

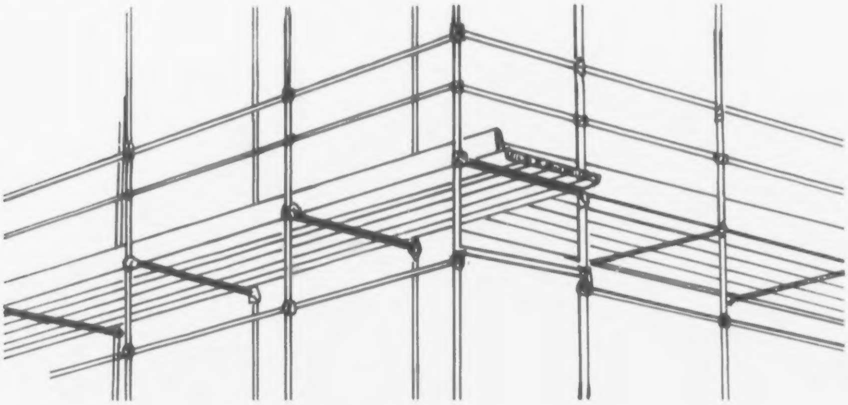


Figures 42 and 43 used with permission of Deal Products, Easton, Pennsylvania.

2. Tubular, locking-type, prefabricated scaffolding

   (NOTE: Tubular locking-type scaffolding can be used in the construction of curved or irregularly shaped structures such as pyramids.)

FIGURE 44*

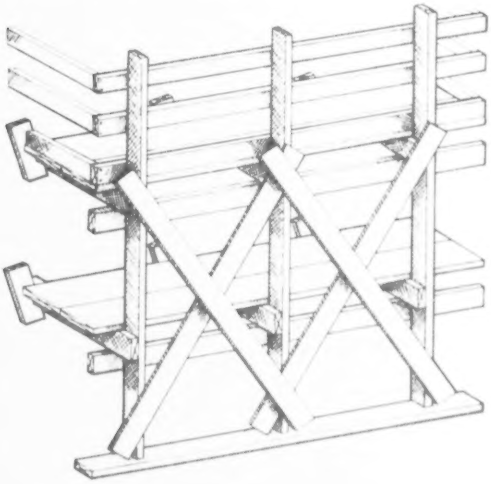


INFORMATION SHEET

B. Job-built scaffolding

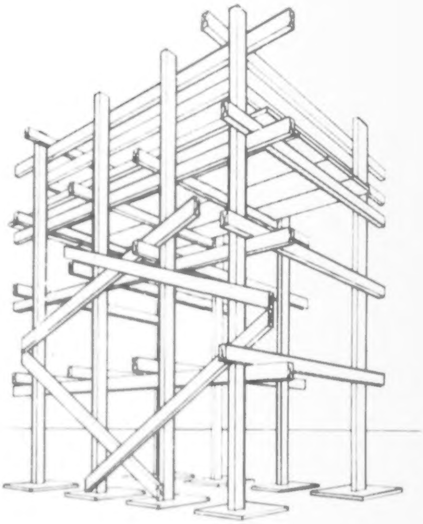
1. Single-pole
job-built scaffolding

FIGURE 45



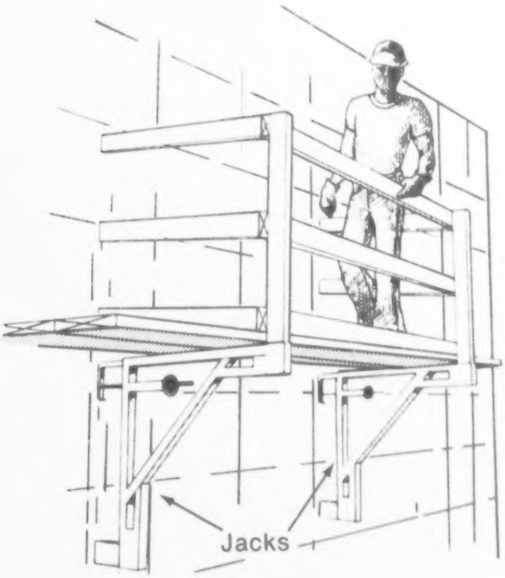
2. Double-pole
job-built scaffolding

FIGURE 46



3. Scaffold jacks with job-built platform

FIGURE 47

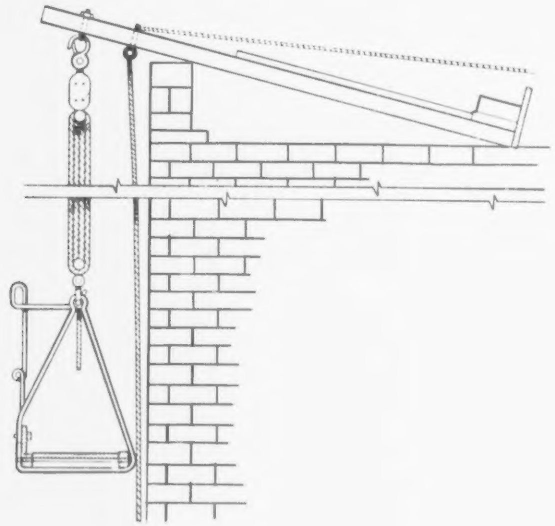


INFORMATION SHEET

C. Swing scaffolding (swing-stage scaffolding; suspended scaffolding; swinging scaffolding)

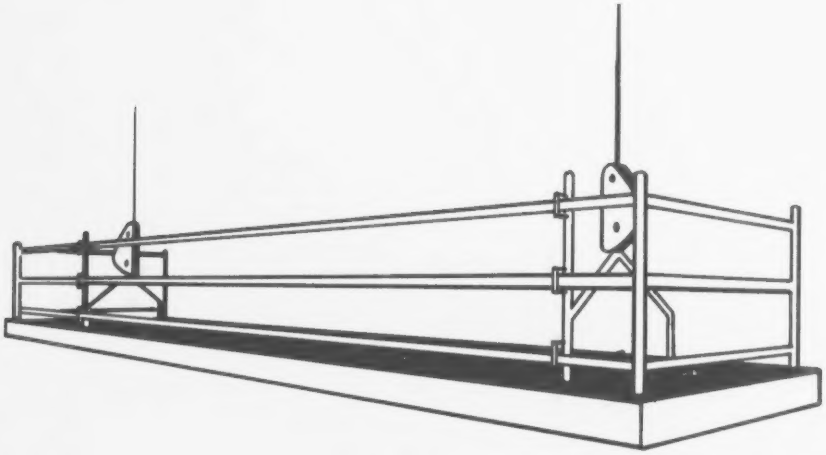
   1. Hand-type swing scaffolding

FIGURE 48



   2. Power-type swing scaffolding

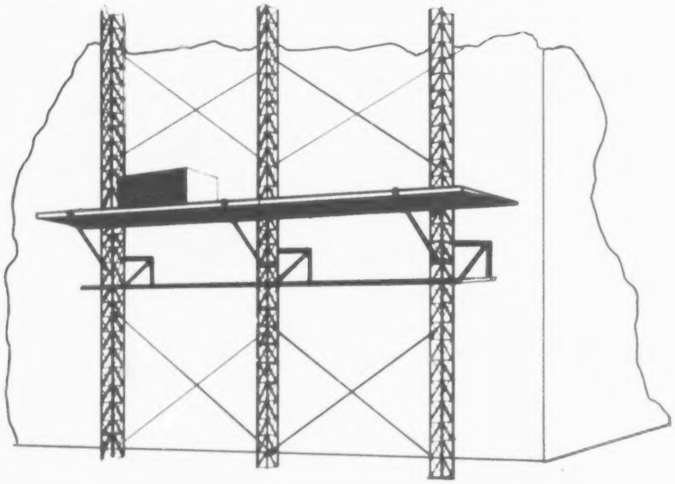
FIGURE 49



INFORMATION SHEET

D. Adjustable scaffolding

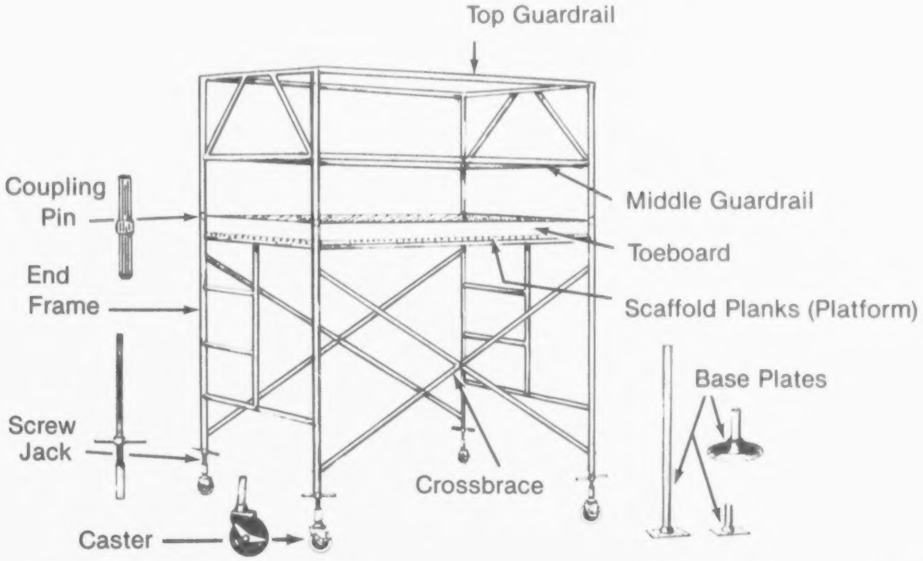
FIGURE 50



X. Parts of prefabricated rolling scaffolding (Figure 51)

(NOTE: OSHA requires that scaffolding consist of the following standard parts: a top guardrail approximately 42 inches high, a midrail halfway between the top guardrail and the toeboard, and a toeboard just above the scaffold planks [platform] if the scaffold planks measure 45 inches or less in width and 4 feet or more in height.)

FIGURE 51


Top Guardrail
Coupling Pin
Middle Guardrail
Toeboard
End Frame
Scaffold Planks (Platform)
Base Plates
Screw Jack
Crossbrace
Caster

INFORMATION SHEET

XI. Safety rules pertaining to ladders

  A. Fully spread and lock stepladder before using

  B. *Do not* use ladders that are not equipped with safety shoes

  C. Always set ladder on firm, level footing

  D. Be sure ladder locking mechanisms work

  E. Check ladder thoroughly before using

  F. *Never* use a ladder near electrical lines

  G. Be sure extension and straight ladders are secured at top and bottom

  H. *Never* work from the top step of a ladder

  I. *Never* overreach from a ladder

  J. Be sure your shoe soles and the ladder rungs are clean and free of grease and mud

  K. *Never* allow more than one person to work on a ladder

  L. *Never* use an extension ladder that is overlapped less than 3 feet

  M. *Never* move a 12-foot or longer ladder by yourself; get assistance

  N. *Never* set a ladder in front of a doorway, aisle, or driveway without securing the area or having someone stand guard

  O. Use both hands when going up or down a ladder

  P. *Never* carry tools in your hands when climbing a ladder

  Q. Use safety equipment when working on or using a fixed ladder

  R. Be sure job-built ladders are built according to OSHA regulations

  S. *Never* use a ladder placed in horizontal position

  T. Remove a ladder when you have finished using it, and always remove and store ladder at end of workday

  U. Secure ladder at both top and bottom to prevent displacement; brace long ladders at intermediate points to prevent spring

  V. Familiarize yourself with local, state, and federal safety requirements and be governed accordingly

INFORMATION SHEET

XII. Safety rule for correct ladder placement — Place ladder approximately one-quarter of its support length away from vertical plane of top support (See Figure 52), and extend ladder at least 3 feet above top support (See Figure 53)

EXAMPLES:

FIGURE 52

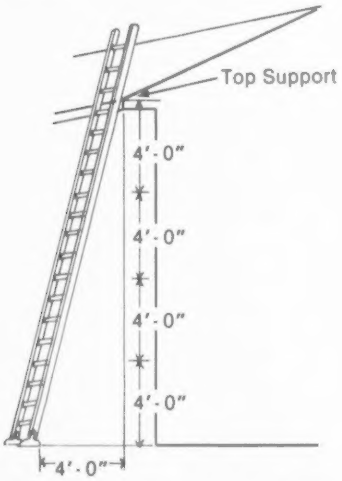
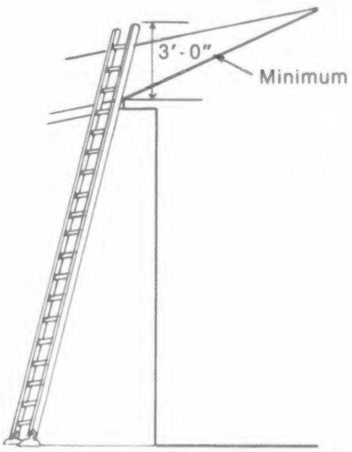


FIGURE 53

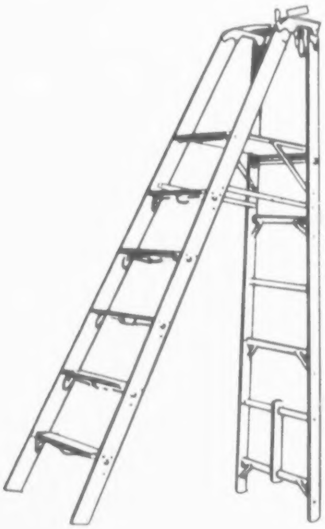


XIII. Types of portable ladders (Figures 54-57)

(NOTE: Portable ladders may be wood, metal, or fiberglass.)

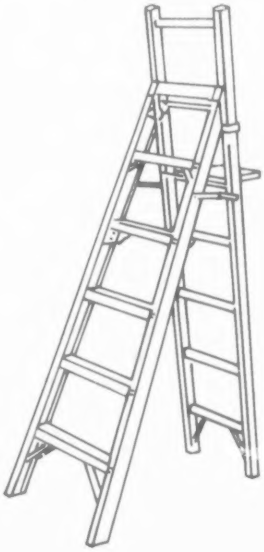
A. Stepladder

FIGURE 54



B. Combination ladder

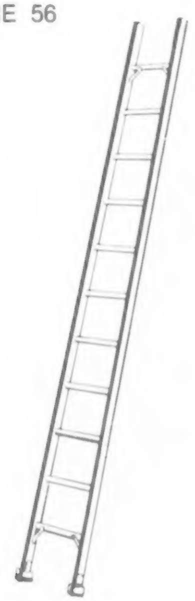
FIGURE 55



INFORMATION SHEET

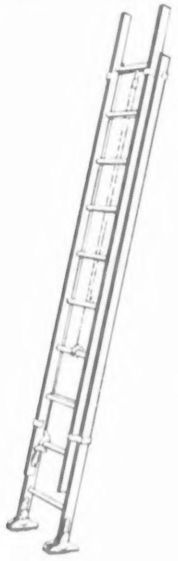
C. Single, straight ladder

FIGURE 56



D. Extension ladder

FIGURE 57



XIV. Terms and definitions associated with rigging

A. Shackle — Device used to connect slings, chokers, or chains to loads

B. Choker — Short piece of rope, cable, or chain with an eye on each end or an eye on one end and a hook on the other end

C. Thimble — Grooved metal ring inserted in eye splices to prevent wear

D. Tag line — Line used to guide and steady load during hoisting

E. Screw-pin shackle — Device connected with a threaded pin that goes through one shackle eye and screws into the other eye

F. Bridle — Two-legged sling that supports a load at two or more points, or two or more chokers fastened to a common ring

XV. Safety rules pertaining to rigging

A. Turn hooks out

B. Use shackles on chokers where there may be cutting action

C. Pad all sharp corners and edges

D. Always make vertical lifts on eyebolts

(NOTE: Lifting at an angle reduces safe load as much as 90 percent.)

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E. Use thimble in eye splices

F. Use a shackle whenever two or more ropes are to be used over a hook

G. Use tag lines to control loads

H. Secure all unused sling lines

I. *Never* wrap a rope around a hook

J. *Do not* permit bending of rope near a splice or attached fitting

K. Block all loads properly before unhooking

L. *Never* allow a shackle to be pulled at an angle

(NOTE: Use washers for packing if necessary.)

M. *Do not* use screw-pin shackle if the pin can roll under load and unscrew

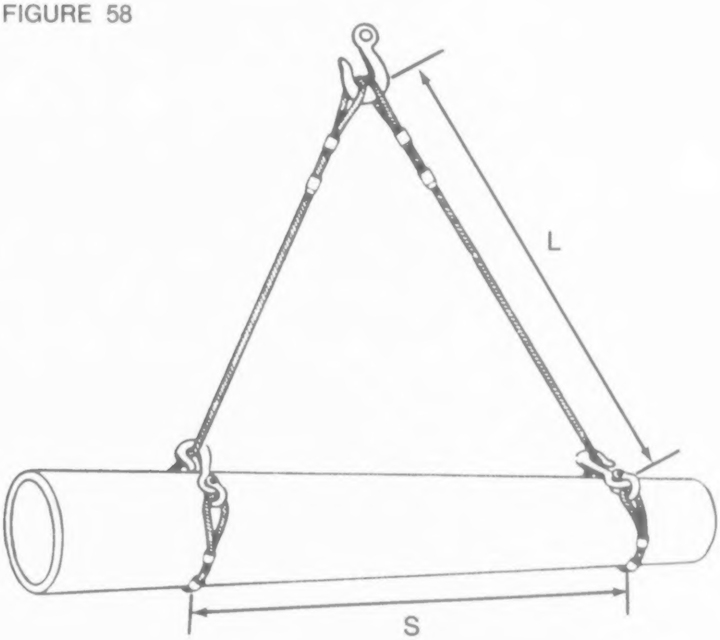
N. Center crane over load before lifting

O. Keep machines at least 10 feet from all electrical equipment

P. For proper sling angle, be sure that length (L) of sling is always greater than span (S) between the two connections (Figure 58)

EXAMPLE: L is greater than S.

FIGURE 58

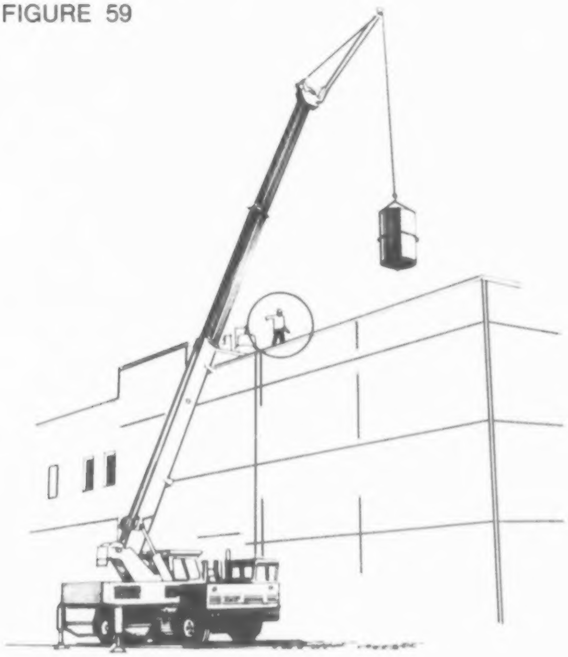


INFORMATION SHEET

XVI. Hoisting and lifting equipment (Figures 59-62)

A. Mobile crane and bucket

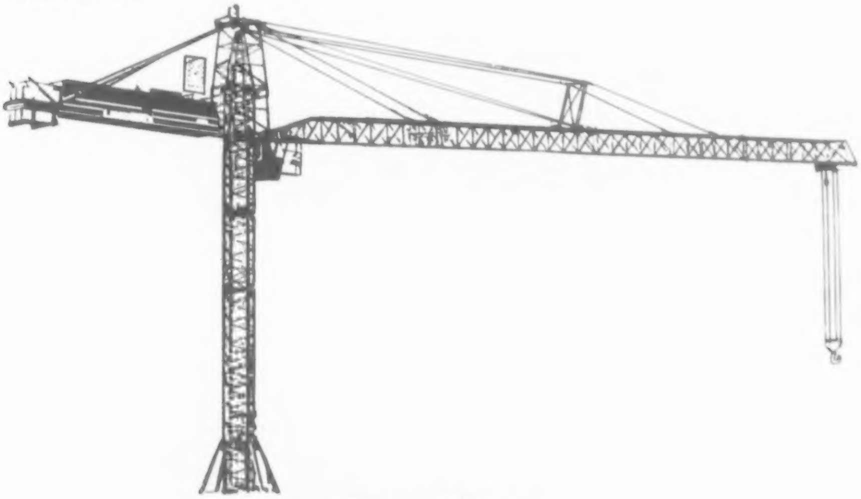
FIGURE 59



Used with permission of the Construction Safety Association of Ontario, from *Crane Handbook*, compiled by D.E. Dickie, 1975.

B. Tower crane

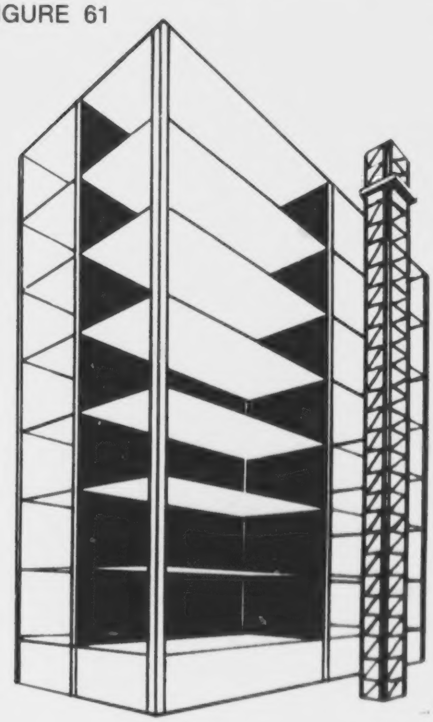
FIGURE 60



INFORMATION SHEET

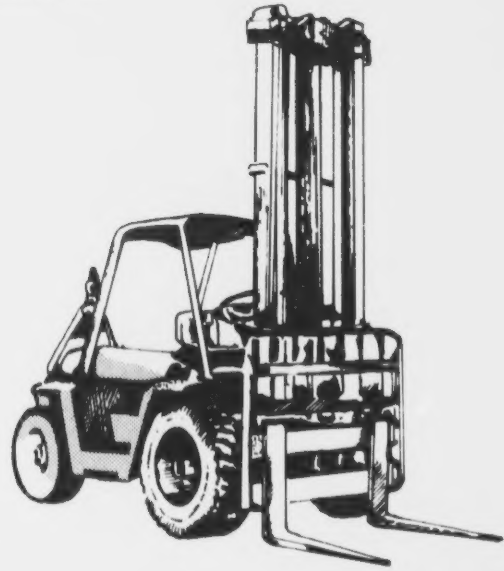
C. Materials-handling tower hoist

FIGURE 61



D. Forklift

FIGURE 62

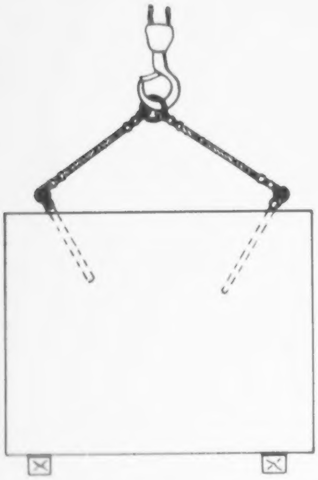


INFORMATION SHEET

XVII. Types of rigging and other devices used for handling panels (Figures 63-75)

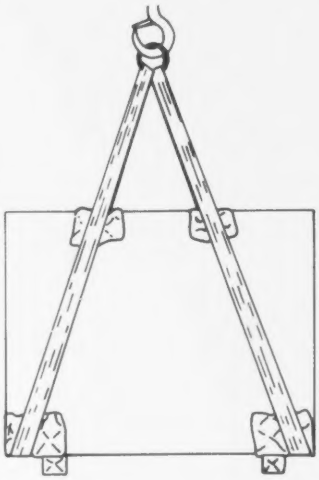
A. Lewis pins and bridle

FIGURE 63



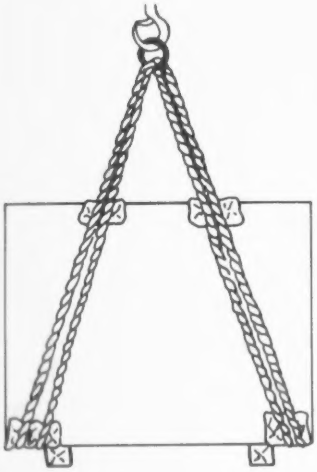
B. Straps (web slings)

FIGURE 64



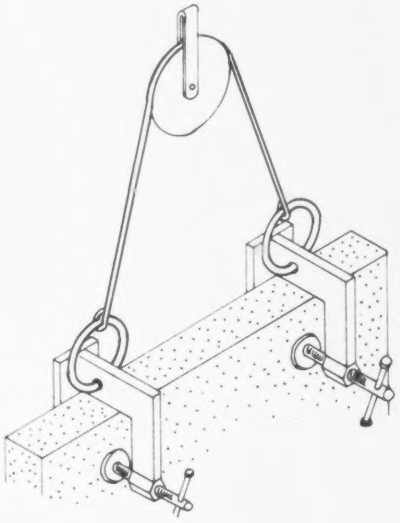
C. Chokers (slings)

FIGURE 65



D. Stone clamps

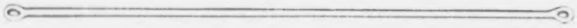
FIGURE 66



INFORMATION SHEET

E. Spreader

FIGURE 67



F. Spreader bar

FIGURE 68

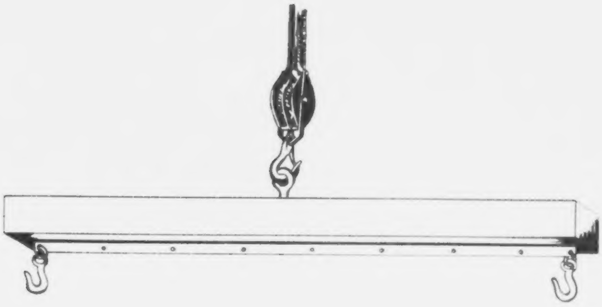
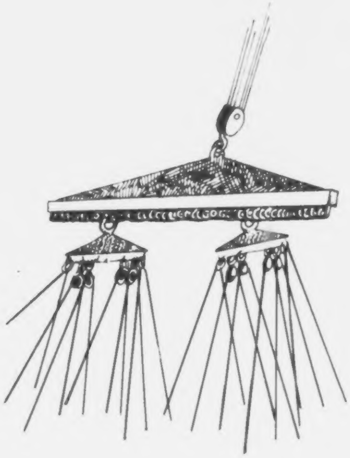


FIGURE 69



G. Bridle

FIGURE 70

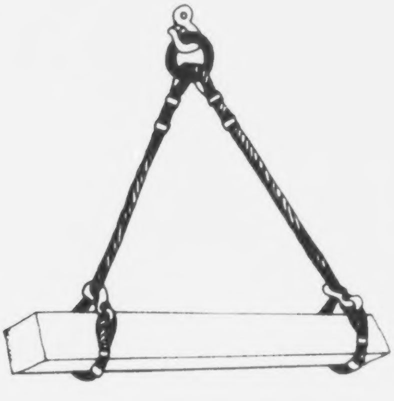
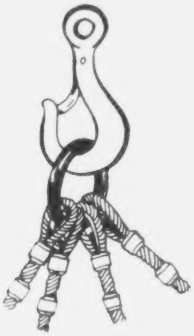


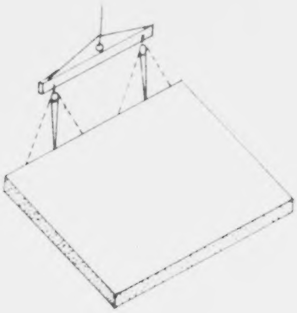
FIGURE 71



INFORMATION SHEET

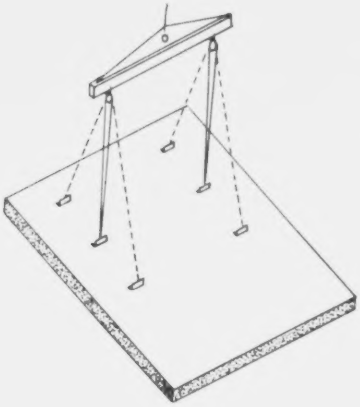
H. Basic edge-lift rigging

FIGURE 72



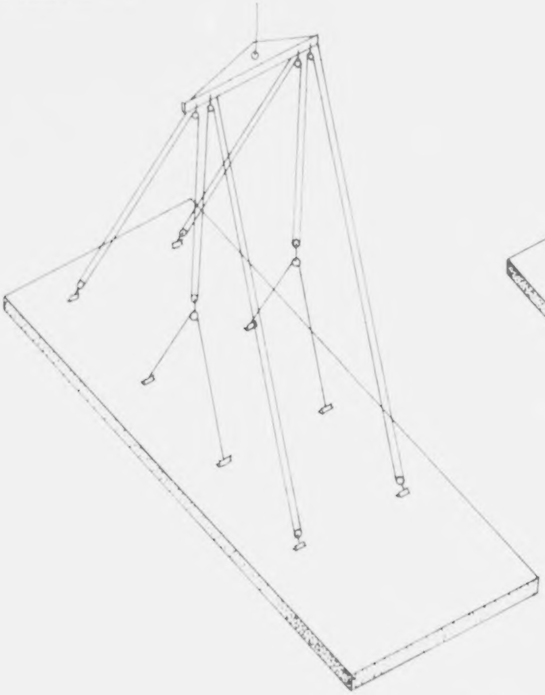
I. Basic two-point-lift rigging

FIGURE 73



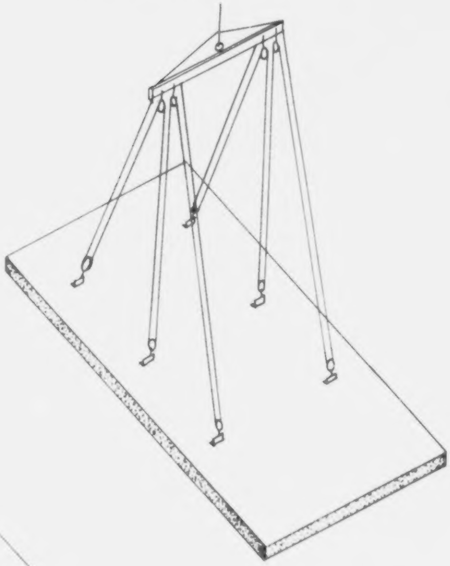
J. High rigging for approximately equal loads

FIGURE 74



K. High rigging modified for panels of various widths

FIGURE 75



INFORMATION SHEET

XVIII. Safety rules pertaining to giving hand signals

A. Only one person gives hand signals

B. Give all hand signals clearly

C. Make sure the equipment operator can see you and is able to acknowledge the signal given

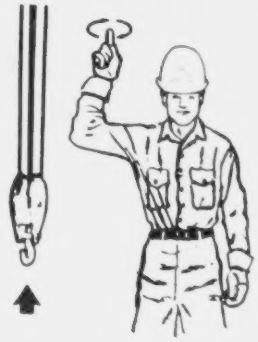
(NOTE: Remember, the signal person watches the load; the equipment operator watches the signal person.)

D. Before beginning hoisting procedure, warn other workers to stay clear of the hoisting area; *never* raise or lower load over other workers

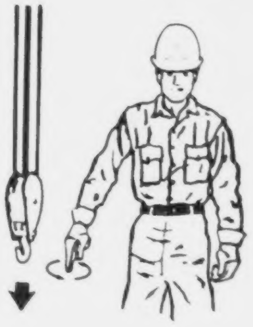
XIX. Hand signals used in rigging and maneuvering operations

A. Hand signals used in rigging operations (Table 1)

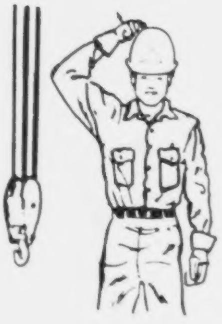
TABLE 1: Hand signals used in rigging operations



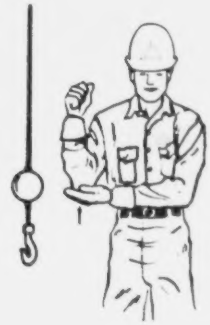
Hoist load.



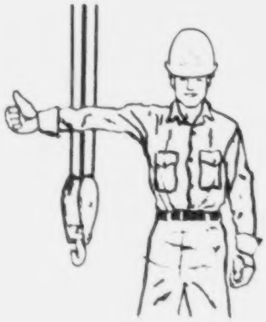
Lower load.



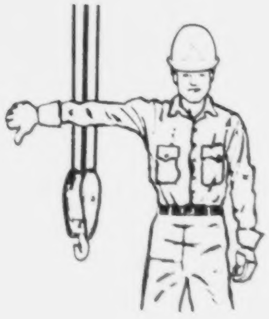
Use main hoist.



Use whipline.



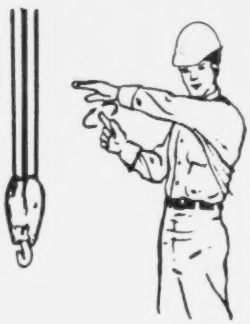
Raise boom.



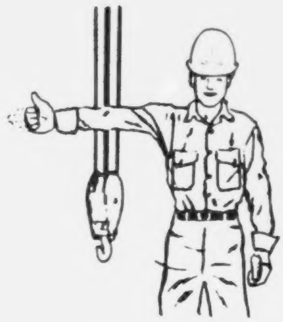
Lower boom.

INFORMATION SHEET

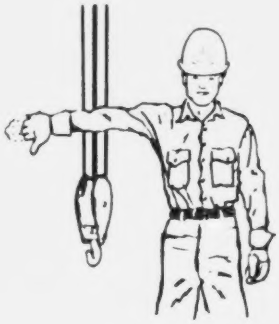
TABLE 1 (Continued)



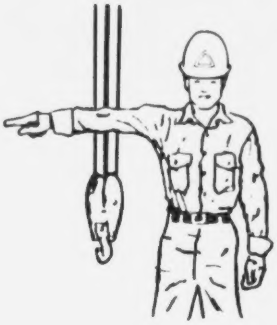
Move slowly.



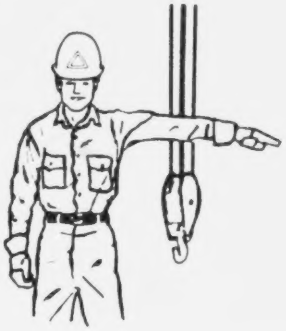
Raise boom and
lower load.



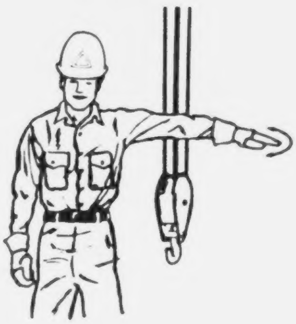
Lower boom and
raise load.



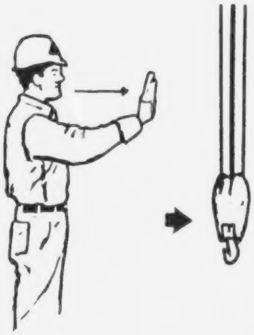
Swing.



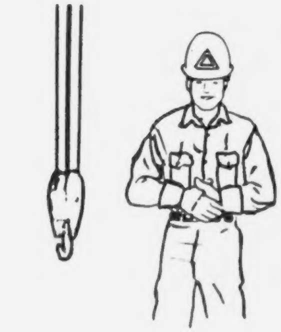
Stop.



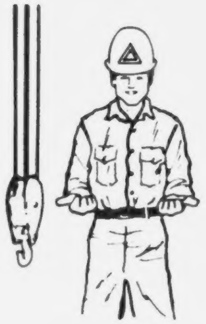
Emergency stop.



Travel.



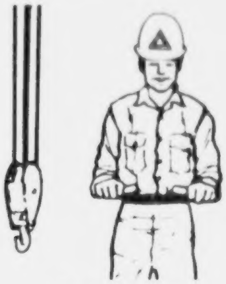
Dog everything.
(Stop immediately.)



Extend boom

INFORMATION SHEET

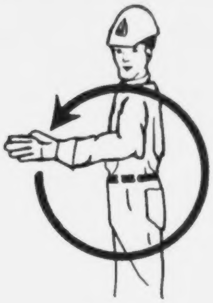
TABLE 1 (Continued)



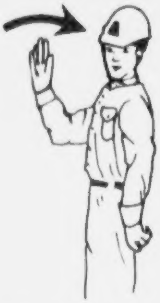
Retract boom.

B. Hand signals used when maneuvering vehicles (Table 2)

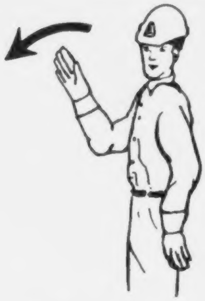
TABLE 2: Hand signals used when maneuvering vehicles



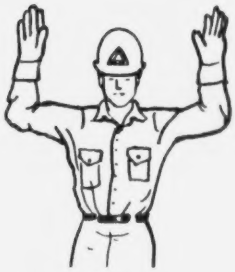
Move.



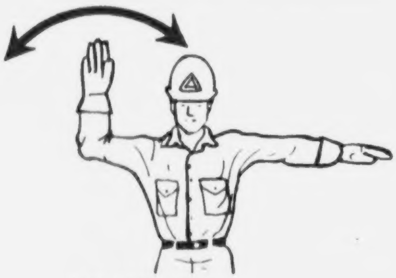
Move backward.



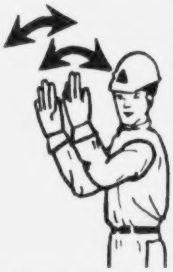
Move forward.



Stop.
(Hold both arms to the side, forearms vertical, hands open, palms facing out.)



Turn while moving.
(One forearm vertical, palm facing forward, move arm back and forth to indicate movement; other arm extended, palm down, point in direction of turn.)

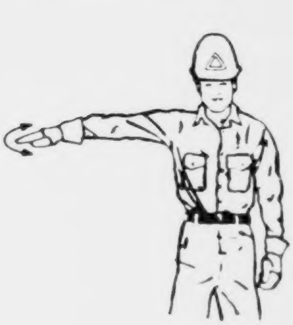


Straighten out.
(Both arms extended forward, forearms vertical, hands open, one palm facing out and the other facing in; move forearms forward and back.)

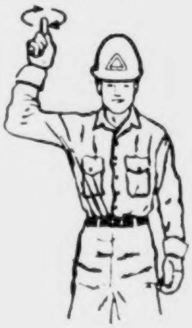
INFORMATION SHEET

XX. Hand signals used in forklift operations (Table 3)

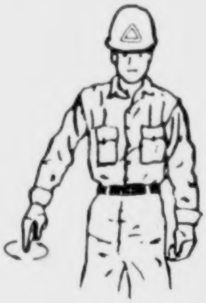
TABLE 3: Hand signals used in forklift operations



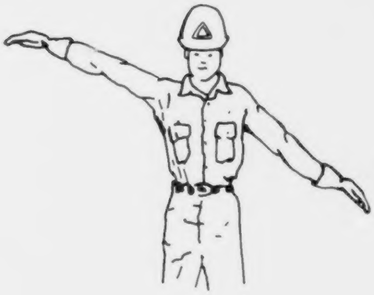
Stop.



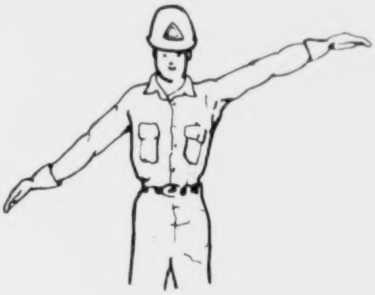
Raise load.



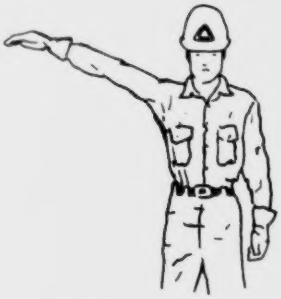
Lower load.



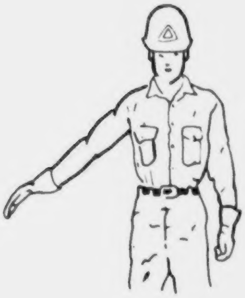
Tilt forks right.



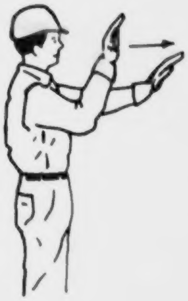
Tilt forks left.



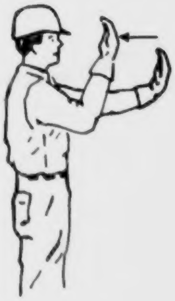
Tilt forks up.



Tilt forks down.



Move load backward.



Move load forward.

MISCELLANEOUS EQUIPMENT
UNIT IV

ASSIGNMENT SHEET #1 — PERFORM SAFETY INSPECTIONS ON VARIOUS TYPES OF LADDERS

NAME ____________________ SCORE ____________

As a cement mason, you will be required to use various types of ladders in your work, and before each use, you should thoroughly inspect the ladder you will be using to make sure that it is safe. The following checklist will aid you in determining whether or not the ladder you will be using is sound and therefore safe.

Your instructor will provide you with several ladders to inspect. Read the checklist below, and then for each of the following items, write a checkmark in the appropriate box. Ladders found deficient in any one of the areas to be checked should be repaired by a qualified person or destroyed.

	Needs repair	Okay
A. Items to be checked on all ladders		
1. Steps or rungs are tight — *not* loose. (Steps and rungs are considered loose if they can be moved with your hand.)	☐	☐
2. Steps or rungs are sound — *not* cracked, split, broken, or slivered.	☐	☐
3. Uprights are sound — *not* broken or slivered.	☐	☐
4. Nails, screws, bolts, and other metal fasteners are secure — *not* loose or missing.	☐	☐
5. Metal fasteners, screws, or nails *do not* protrude so that they catch worker's clothing.	☐	☐
6. Nonslip bases are in good condition — *not* worn, gummed up, or coated with a foreign substance.	☐	☐
B. Items to be checked on stepladders		
1. Ladder bears evenly on all four legs and *does not* wobble from side strain.	☐	☐
2. Hinge spreaders are in good condition — *not* loose or bent.	☐	☐
3. Hinge spreaders are equipped with a "stop."	☐	☐

ASSIGNMENT SHEET #1

	Needs repair	Okay
Stepladders (Continued)		
4. Diagonal bracing and dowels on rear section of ladder are in good condition — *not* deformed by workers climbing on them.	☐	☐
5. Hinge spreaders *do not* present a serious finger-pinching hazard.	☐	☐
C. Items to be checked on extension ladders		
1. Extension locks are in good condition — *not* loose, broken, or missing.	☐	☐
2. Locks work properly when the ladder is extended.	☐	☐
3. Rope is in good condition — *not* deteriorated from exposure to acid or other destructive agents.	☐	☐

MISCELLANEOUS EQUIPMENT
UNIT IV

ASSIGNMENT SHEET #2 — DISTINGUISH AMONG HAND SIGNALS USED IN RIGGING AND MANEUVERING OPERATIONS AND IN FORKLIFT OPERATIONS

NAME ______________________________ SCORE ______________

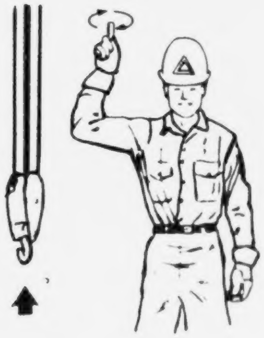
When performing construction operations in which rigging and maneuvering operations are required, you must know the proper hand signals to give to the equipment operator. By knowing the proper hand signals, you can avoid dangerous situations and prevent serious accidents.

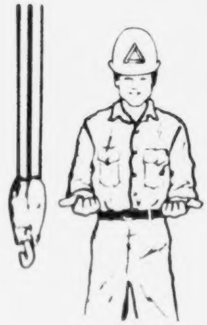
This assignment sheet will give you practice in recognizing the proper hand signal to give for various maneuvers. Read the directions in each of the sections below to complete this practice exercise.

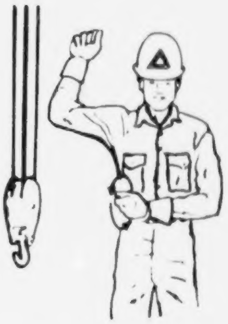
PART I

Distinguish among the following hand signals used in rigging and maneuvering operations by writing an "X" in the blank under the correct illustration.

A. **Hoist load**

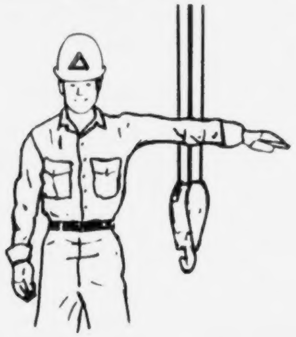


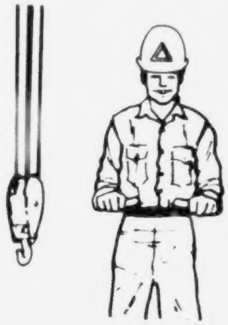


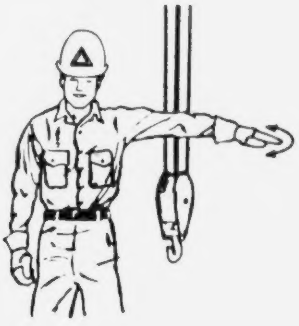


1. ______________ 2. ______________ 3. ______________

B. **Emergency stop**



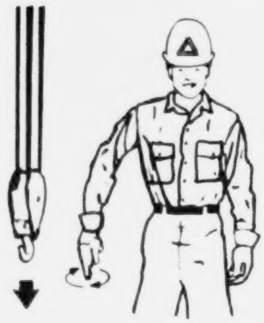
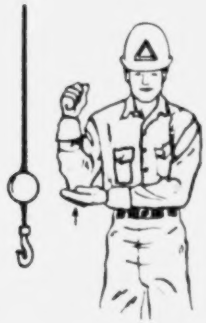
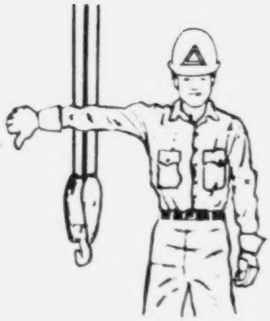




1. ______________ 2. ______________ 3. ______________

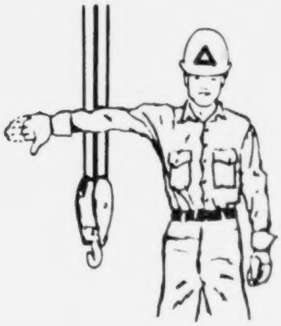
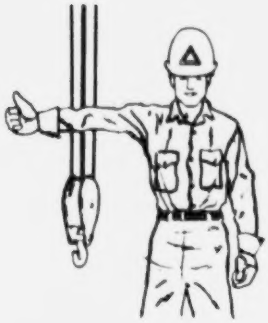
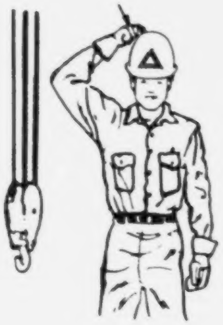
ASSIGNMENT SHEET #2

C. Lower boom

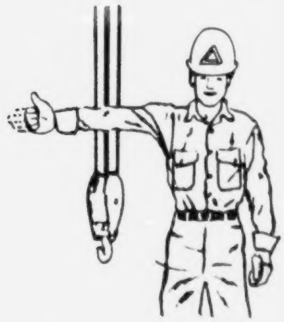
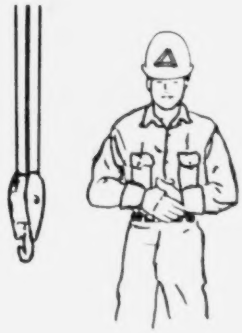
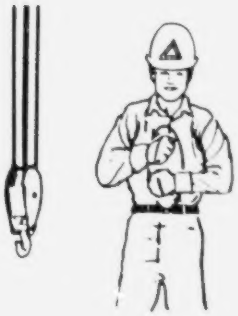
1. ______________________ 2. ______________________ 3.______________________

D. Lower boom and raise load

1. ______________________ 2. ______________________ 3.______________________

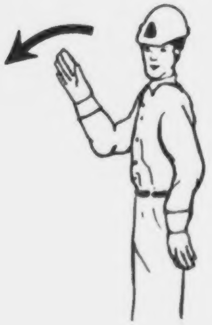
E. Dog everything

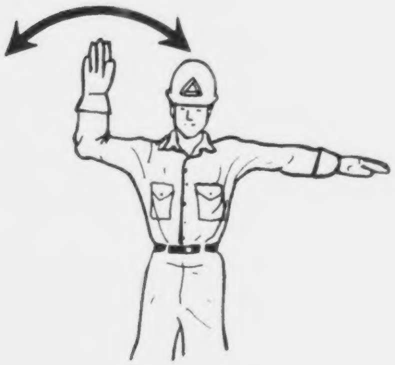




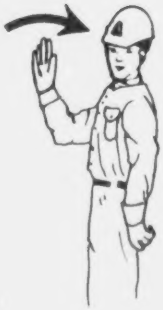
1. ______________________ 2. ______________________ 3.______________________

ASSIGNMENT SHEET #2

F. **Turn while moving**







1. ______________________ 2. ______________________ 3.______________________

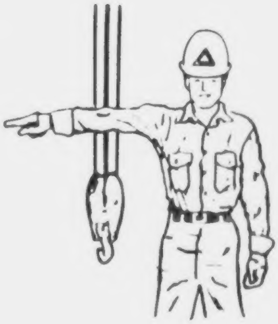
PART II

Distinguish among the following hand signals used in rigging and maneuvering operations by writing an "X" in the blank before each correct statement.

A. _____1. Turn while moving

_____2. Swing

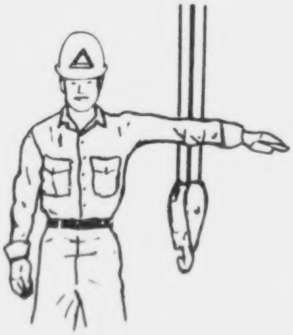
_____3. Move in this direction



B. _____1. Move in this direction

_____2. Stop

_____3. Raise boom

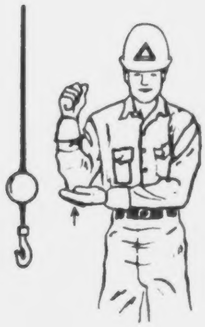


ASSIGNMENT SHEET #2

C. _____1. Emergency stop

_____2. Rehaul or retract

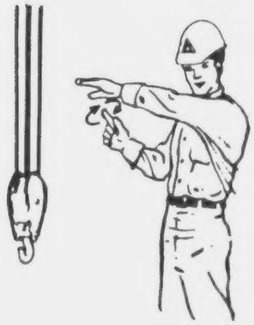
_____3. Use whipline



D. _____1. Lower boom and hold load

_____2. Lower boom and raise load

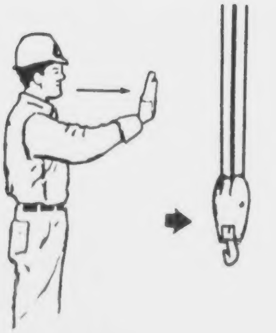
_____3. Move slowly



E. _____1. Lower load

_____2. Lower boom

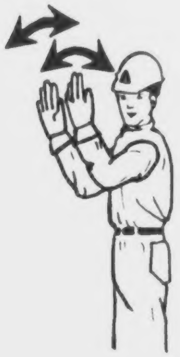
_____3. Travel



F. _____1. Stop

_____2. Straighten out

_____3. Turn while moving

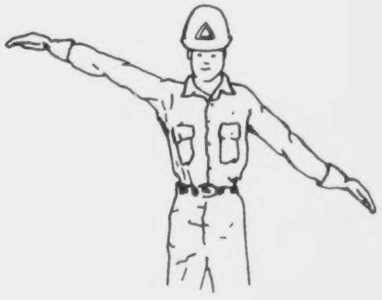


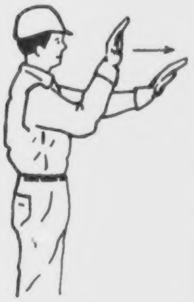
ASSIGNMENT SHEET #2

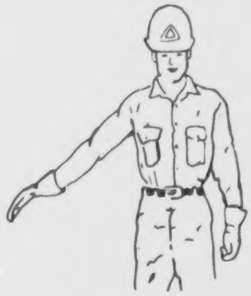
PART III

Distinguish among the hand signals used in forklift operations. For each of the following, write an "X" in the blank below the correct illustration.

A. **Tilt forks down**

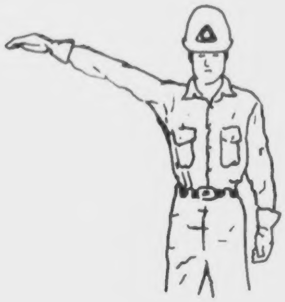


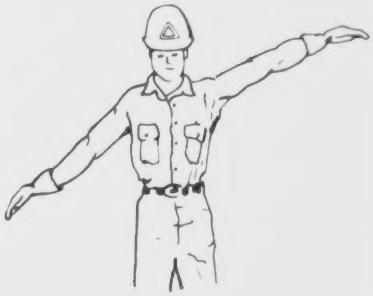


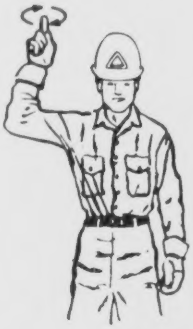


1. ____________ 2. ____________ 3. ____________

B. **Tilt forks left**

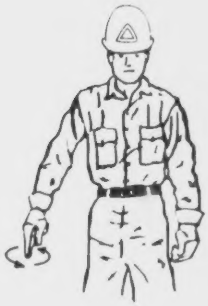


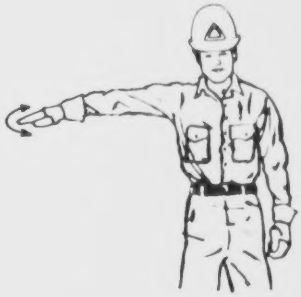


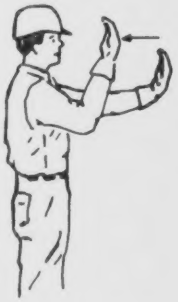


1. ____________ 2. ____________ 3. ____________

C. **Lower load**



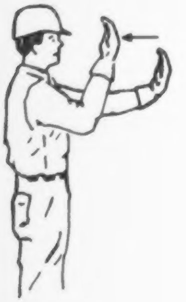


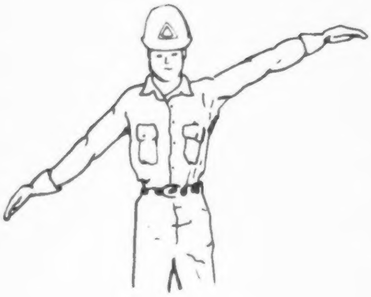


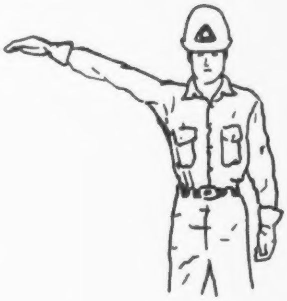
1. ____________ 2. ____________ 3. ____________

ASSIGNMENT SHEET #2

D. **Move load forward**

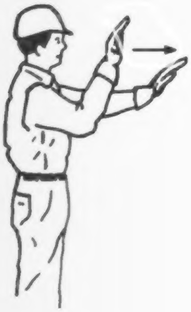


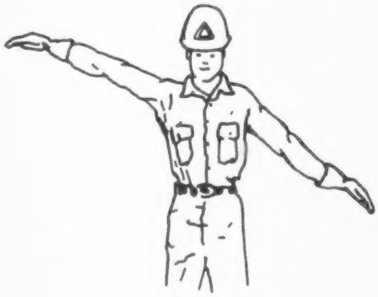


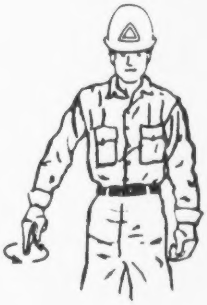


1. ____________________ 2. ____________________ 3.____________________

E. **Tilt forks right**

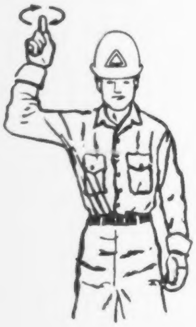


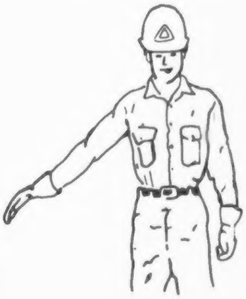


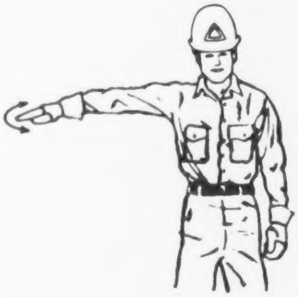


1. ____________________ 2. ____________________ 3.____________________

F. **Raise load**



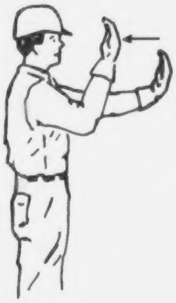


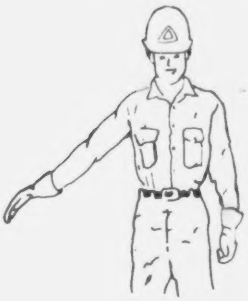


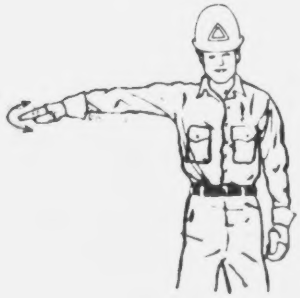
1. ____________________ 2. ____________________ 3.____________________

ASSIGNMENT SHEET #2

G. **Stop**

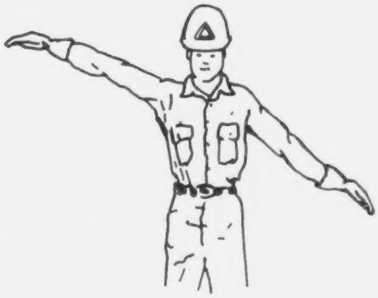


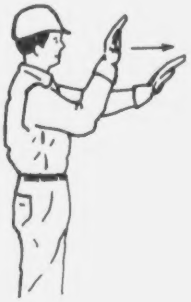


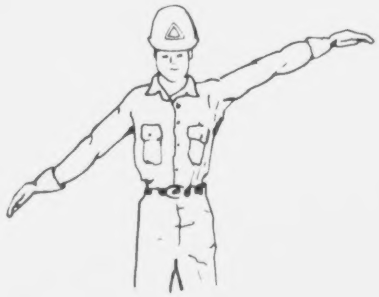


1. ______________________ 2. ______________________ 3.______________________

H. **Move load backward**







1. ______________________ 2. ______________________ 3.______________________

MISCELLANEOUS EQUIPMENT
UNIT III

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

Evaluated to the satisfaction of the instructor.

Assignment Sheet #2

PART I

A. 1
B. 3
C. 3
D. 1
E. 2
F. 2

PART II

A. 2
B. 2
C. 3
D. 3
E. 3
F. 2

PART III

A. 3
B. 2
C. 1
D. 1
E. 2
F. 1
G. 3
H. 2

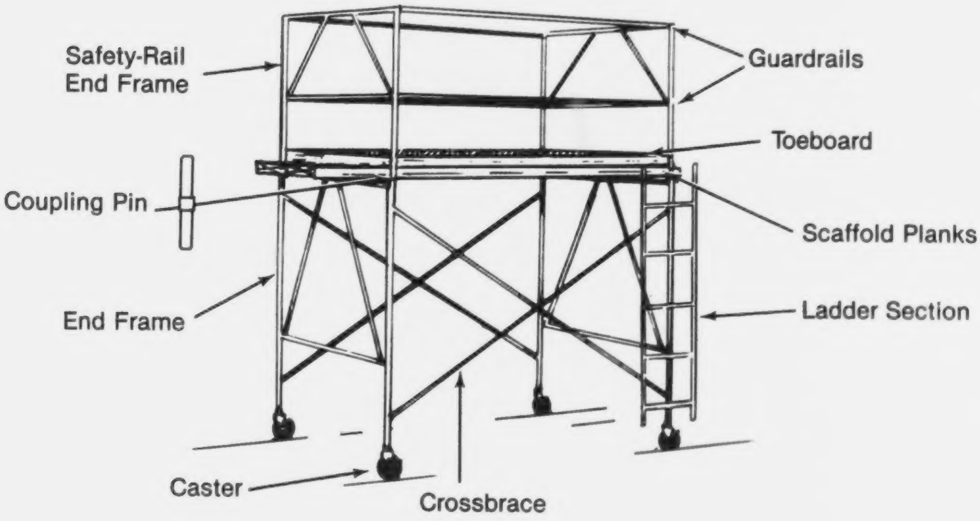
MISCELLANEOUS EQUIPMENT
UNIT IV

JOB SHEET #1 — SET UP A SECTION OF PREFABRICATED ROLLING SCAFFOLDING

I. Equipment

(NOTE: Study the drawing in Figure 76, and then assemble the equipment listed below the drawing.)

FIGURE 76


Safety-Rail
End Frame
Guardrails
Toeboard
Coupling Pin
Scaffold Planks
End Frame
Ladder Section
Caster
Crossbrace

A. Two end frames

B. Two safety-rail end frames

C. Two sets of crossbraces

D. Two scaffold planks equipped with safety cleats

E. Four guardrails

F. Four toeboards

G. Four coupling pins

H. Four casters

I. One ladder section

II. Procedure

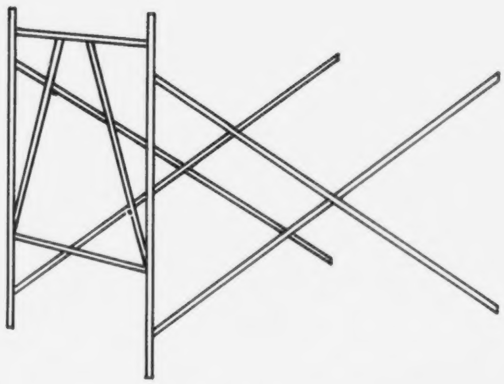
A. Place end frames on level floor

B. Stand one end frame up and secure one end of both sets of crossbraces to end frame (See Figure 77)

C. Tilt end frame to rest on crossbraces (See Figure 77)

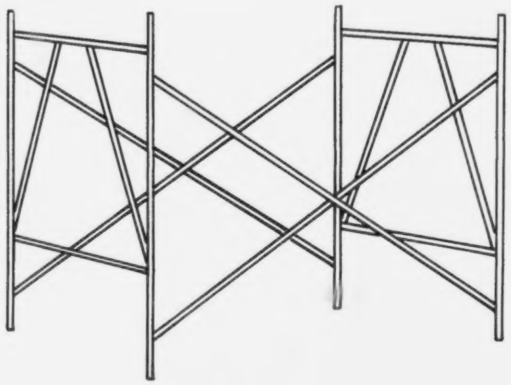
JOB SHEET #1

FIGURE 77



D. Stand second end frame up and secure other end of both sets of crossbraces to end frame (Figure 78)

FIGURE 78



E. Set scaffold planks on top of end frames, safety cleats facing down (See Figure 79)

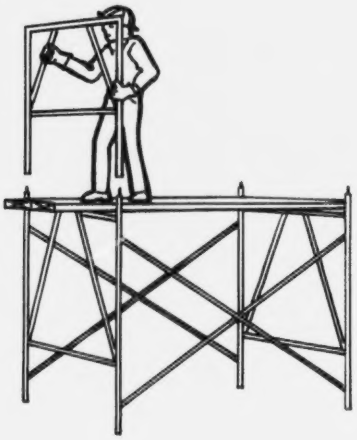
F. Set coupling pins in end frames (See Figure 79)

G. Lift safety-rail end frames onto scaffold planks

H. Climb onto scaffold planks, and set one safety-rail end frame over one set of coupling pins (See Figure 79)

JOB SHEET #1

FIGURE 79



I. Set second safety-rail end frame over remaining coupling pins

J. Secure toeboards to safety-rail end-frame uprights (See Figure 80)

K. Secure guardrails to safety-rail end-frame uprights (See Figure 80)

L. Climb down from scaffold

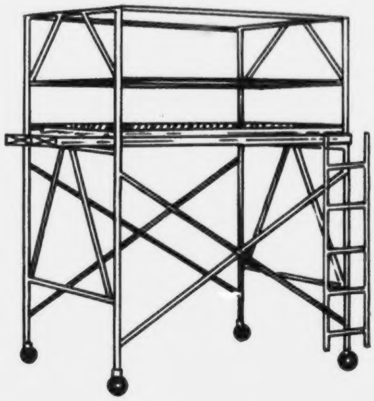
M. Lift one end of scaffold and insert casters; set caster brakes (See Figure 80)

N. Lift other end of scaffold and insert casters; set caster brakes (See Figure 80)

O. Attach ladder section to end-frame upright as shown in Figure 80

P. Inspect completed scaffold (Figure 80)

FIGURE 80



JOB SHEET #1

Q. Have instructor inspect completed scaffold

R. Disassemble scaffold, clean work area, and properly store equipment

MISCELLANEOUS EQUIPMENT
UNIT IV

JOB SHEET #2 — RIG AND HANDLE AN EXTRA-LONG LOAD

I. Equipment

   A. Hoist

   B. Properly blocked load

   (NOTE: The exact weight of the load must be determined prior to rigging the load to ensure that the load will not exceed the lifting capacity of the hoist or the safe working load of the wire-rope slings.)

   C. Wire-rope hook slings

   (NOTE: The length and strength of the wire-rope slings are to be determined by the instructor.)

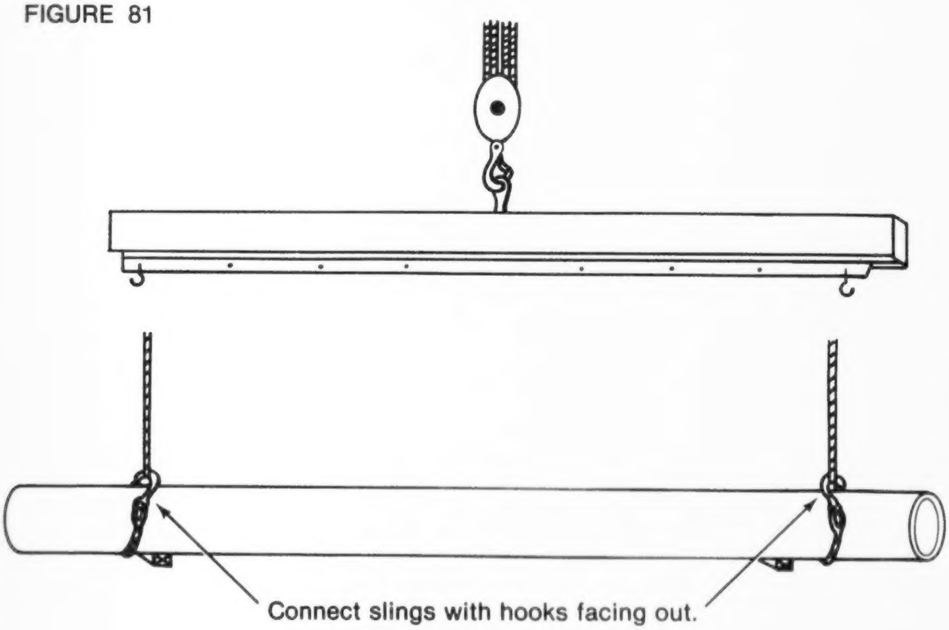
   D. Spreader bar equipped with hooks

II. Procedure

   A. Attach spreader bar to hoist hook (See Figure 81)

   B. Center spreader bar over load; then connect hook ends of slings to ends of load; be sure hooks are facing out (Figure 81)

FIGURE 81

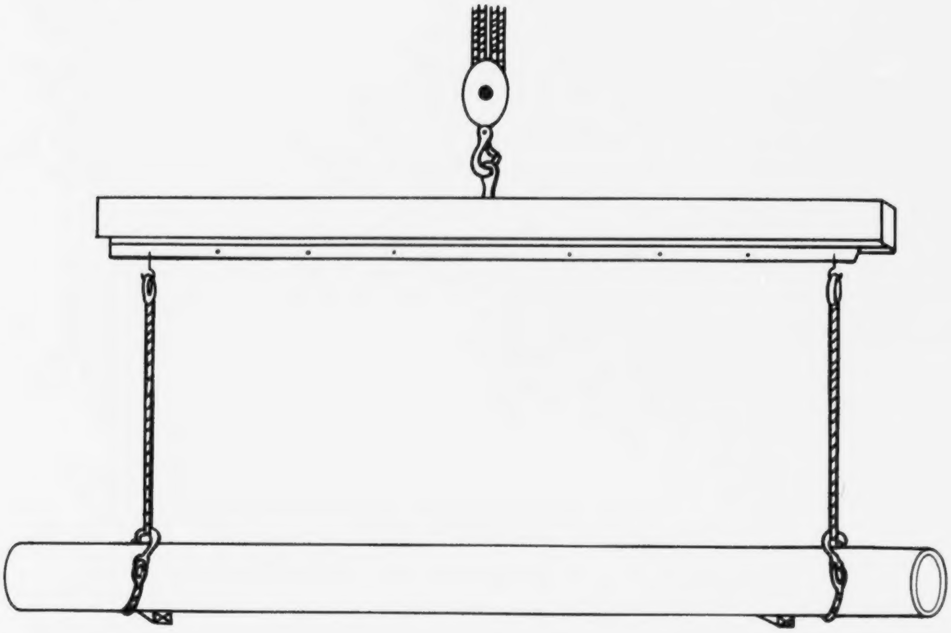


Connect slings with hooks facing out.

JOB SHEET #2

C. Connect other ends of slings to spreader-bar hooks (Figure 82)

FIGURE 82



D. Have instructor check rigging and remain available to supervise procedures in Steps E through G

E. Check balance of load

   1. Give signal to hoist load slowly until load is just a few inches off the blocks and a strain has been put on the line

   2. Give signal to stop

   3. Check load to see that it is properly balanced

F. *If* load is *not* properly balanced,

   1. Give signal to lower load slowly until load is resting on blocks

   2. Give signal to stop

   3. Readjust slings, following the procedure in Step B

   4. Recheck balance of load, following the procedure in Step E

JOB SHEET #2

G. *If* load is properly balanced,

1. Give signal to lower load slowly until load is resting on blocks
2. Give signal to stop
3. Disconnect rigging, clean work area, and properly store equipment

MISCELLANEOUS EQUIPMENT
UNIT IV

JOB SHEET #3 — RIG AND HANDLE A LOAD TO BE ROTATED

I. Equipment

A. Hoist

B. Properly blocked load

(NOTE: The exact weight of the load must be determined prior to rigging the load to ensure that the load will not exceed the lifting capacity of the hoist or the safe working load of the wire-rope sling.)

C. Single wire-rope sling

(NOTE: The length and strength of the wire-rope sling are to be determined by the instructor.)

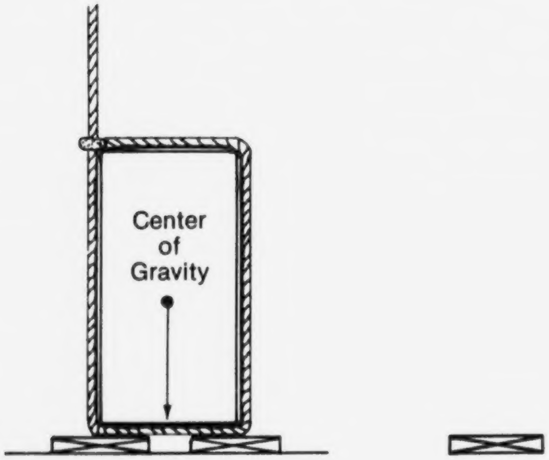
D. Extra block for load to rest upon after being rotated

II. Procedure

A. Arrange extra block in position to accept rotated load (See Figure 83)

B. Arrange sling as a choker hitch so that the part of the sling leading from the hoist hook will go directly to the bottom of the load (Figure 83)

FIGURE 83



JOB SHEET #3

C. Attach sling to hoist hook (See Figure 84)

D. Have instructor check rigging and block placement and then remain available to supervise procedure in Step E

E. Rotate load

1. Give signal to hoist load slowly and to move boom so that hook moves forward until load tilts (Figure 84)

FIGURE 84

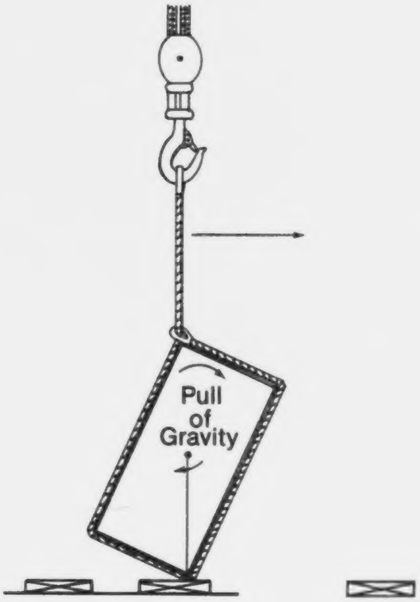
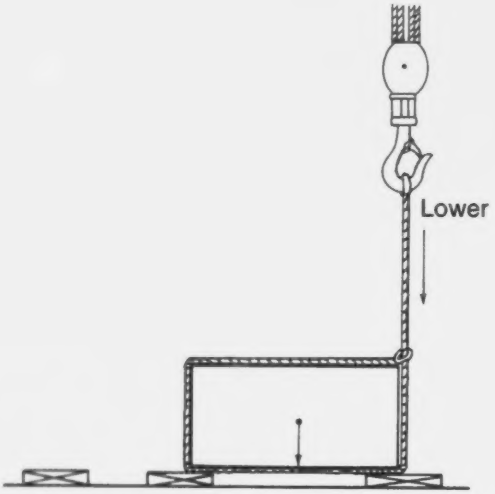


FIGURE 85



2. Give signal to stop hoisting

3. Give signal to move hook forward and to lower hook slowly until load rests in flat position on blocks (See Figure 85)

4. Give signal to stop both forward and lowering movements of the hook

F. Disconnect rigging, clean work area, and properly store equipment

MISCELLANEOUS EQUIPMENT
UNIT IV

JOB SHEET #4 — RIG AND HANDLE A NONCENTERED LOAD

I. Equipment

- A. Hoist
- B. Load fitted with lifting lugs

  (NTOE: The exact weight of the load must be determined prior to rigging the load to ensure that the load will not exceed the lifting capacity of the hoist or the safe working load of the wire-rope slings.)

- C. Wire-rope slings

  (NOTE: The strength of the wire-rope slings is to be determined by the instructor.)

- D. Cable clips
- E. Shakle

II. Procedure

- A. Estimate location of load's center of gravity (See Figure 86)

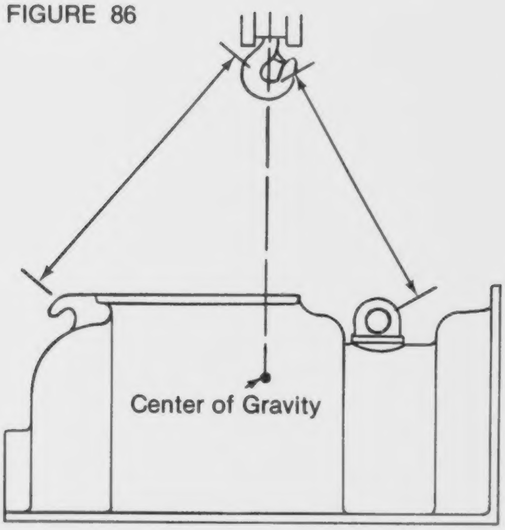
  (NOTE: If the load is lifted without regard to the position of the center of gravity, the load will tilt.)

- B. Spot crane over the load's center of gravity (See Figure 86)
- C. Estimate length of slings required to reach from hoist hook to each lifting lug (See Figure 86)

  (NOTE: When estimating the length of a sling to be used with an eye lug, allow for the shakle that must be used with an eye lug.)

JOB SHEET #4

FIGURE 86


Center of Gravity

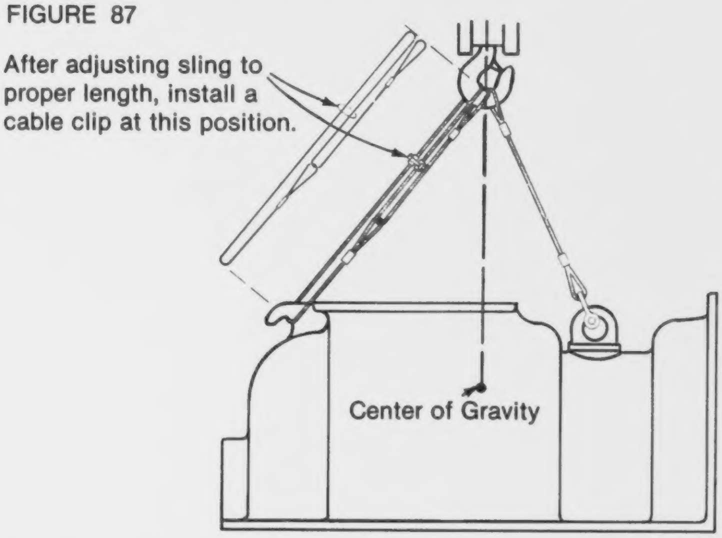
Adapted with permission of McGraw-Hill Book Company, from *Handbook of Rigging* by W.E. Rossnagel, 1957.

D. If possible, obtain slings of the exact lengths required

(NOTE: Often slings of the exact lengths required are not available. If this is the case, follow the procedures in Step E.)

E. *If* slings of the proper length are not available, adjust slings to proper length and install a cable clip as shown in Figure 87

FIGURE 87


After adjusting sling to proper length, install a cable clip at this position.
Center of Gravity

Used with permission of the McGraw-Hill Book Company, from *Handbook of Rigging*, by W.E. Rossnagel, 1957.

JOB SHEET #4

F. Have instructor check rigging and remain available to supervise procedures in Steps G through I

G. Check balance of load

1. Give signal to hoist load slowly until load is just a few inches off the ground and strain has been put on line
2. Give signal to stop
3. Check load to see that it is properly balanced

H. *If* load is *not* properly balanced,

1. Give signal to lower load slowly until load is resting on ground
2. Give signal to stop
3. Readjust slings, following the proceudre in Step E
4. Recheck balance of load, following the procedures in Step G

I. *If* load is properly balanced,

1. Give signal to lower load slowly until load is resting on ground
2. Give signal to stop
3. Disconnect rigging, clean work area, and properly store equipment

MISCELLANEOUS EQUIPMENT
UNIT IV

TEST

NAME ________________________________ SCORE ______________

1. Select correct definitions of terms associated with concrete equipment. Write an "X" in the blank before the best definition.

a. **Tremie**

______1. Flexible drop chute through which concrete is deposited into deep forms

______2. Machine used to agitate fresh concrete in order to consolidate concrete and to eliminate voids, including entrapped air

______3. Pipe or tube with a top in the form of a hopper; used for depositing concrete under water

b. **Elephant trunk**

______1. Flexible drop chute through which concrete is deposited into deep forms

______2. Machine used to agitate fresh concrete in order to consolidate concrete and to eliminate voids, including entrapped air

______3. Pipe or tube with a top in the form of a hopper; used for depositing concrete under water

c. **Vibrator**

______1. Flexible drop chute through which concrete is deposited into deep forms

______2. Machine used to agitate fresh concrete in order to consolidate concrete and to eliminate voids, including entrapped air

______3. Pipe or tube with a top in the form of a hopper; used for depositing concrete under water

d. **Scabble**

______1. To agitate fresh concrete in order to consolidate concrete and to eliminate voids, including entrapped air

______2. To remove concrete surface with a stream of sand ejected from a nozzle at high speed by compressed air; often used to clean horizontal construction joints or to expose aggregate

______3. To work or shape roughly

TEST

e. **Sandblast**

______1. To raise a concrete slab by pumping grout under the slab

______2. To agitate fresh concrete in order to consolidate concrete and to eliminate voids, including entrapped air

______3. To remove concrete surface with a stream of sand ejected from a nozzle at high speed by compressed air; often used to clean horizontal construction joints or to expose aggregate

f. **Slab jack**

______1. To raise a concrete slab by pumping grout under the slab

______2. To hoist floor and roof slabs on or at ground level into position by jacking

______3. To remove concrete surface with a stream of sand ejected from a nozzle at high speed by compressed air; often used to clean horizontal construction joints or to expose aggregate

g. **Shotcrete (gunite)**

______1. Machine used to agitate fresh concrete in order to consolidate concrete and to eliminate voids, including entrapped air

______2. Pneumatically applied concrete; process where cement mixtures are projected at high speed by compressed air onto a surface

______3. Sand ejected from a nozzle at high speed by compressed air; often used to clean up horizontal construction joints or to expose aggregate

h. **Lift-slab**

______1. Method of concrete construction in which floor and roof slabs on or at ground level are hoisted into position by jacking

______2. Method of raising a concrete slab by pumping grout under the slab

______3. Method of working or shaping concrete roughly

2. State five general safety rules pertaining to concrete equipment use.

a. ____

b. ____

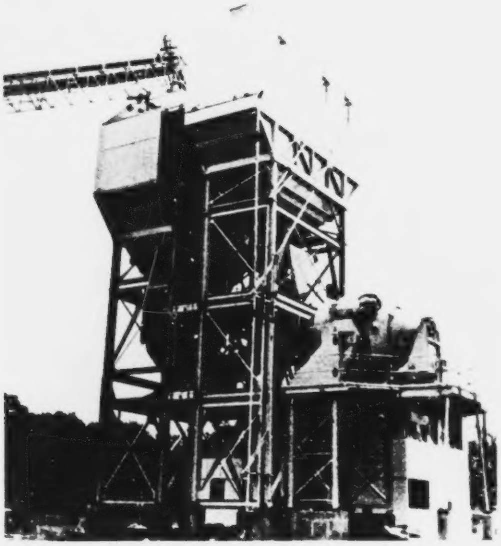
c. ____

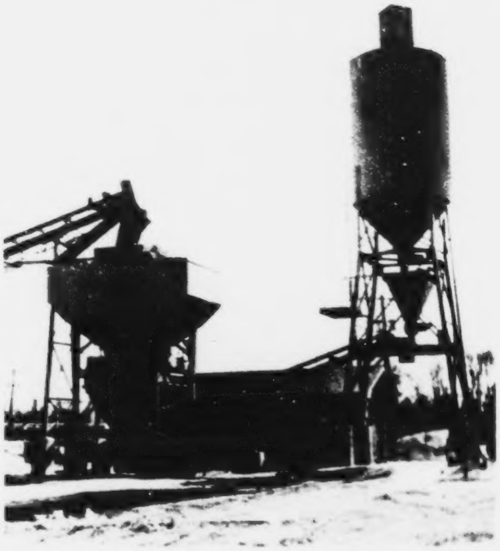
d. ____

e. ____

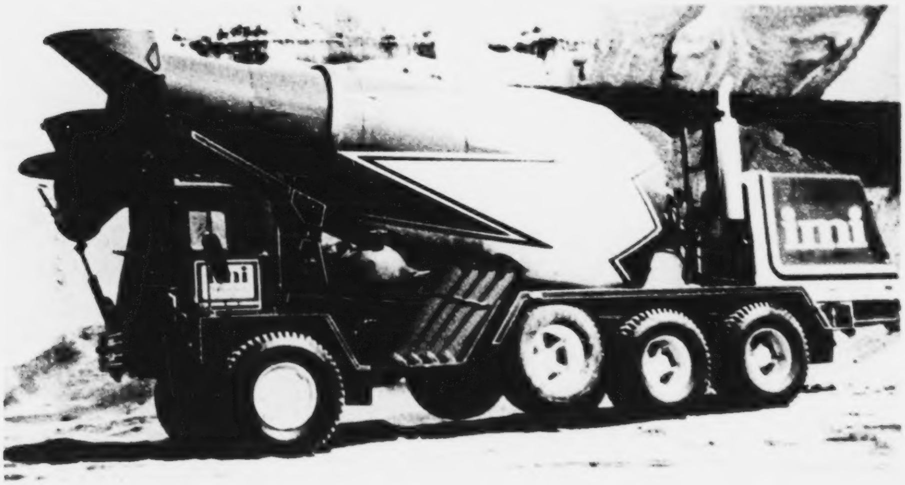
TEST

3. Label the following illustrations of equipment used for mixing concrete.





a. ______________________________ b. ______________________________



c. ______________________________

TEST

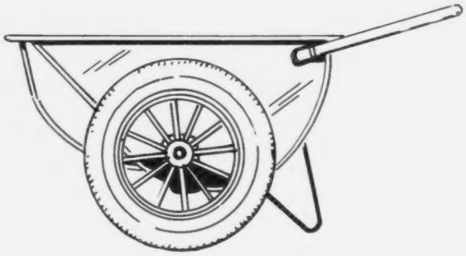
4. Identify the following equipment used for transporting and placing fresh concrete. Write the correct names in the blanks.

Buggies and wheelbarrows

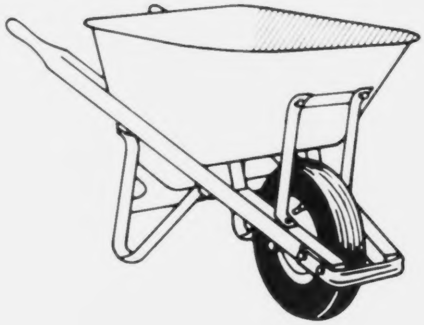
Hand buggy

Power buggy

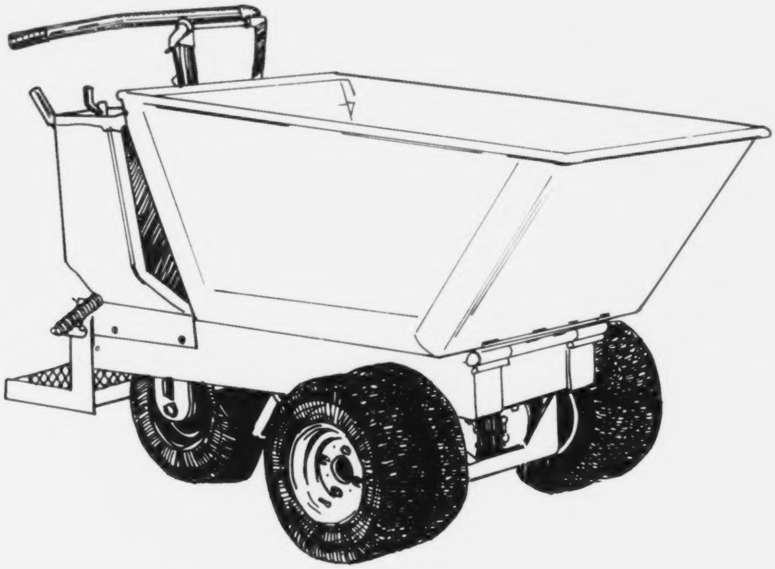
Wheelbarrow



a. ______________________________



b. ______________________________

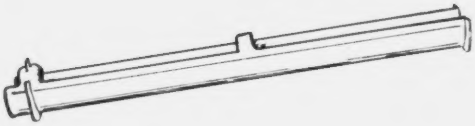


c. ______________________________

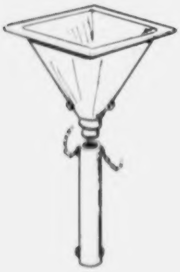
TEST

Hoppers and chutes

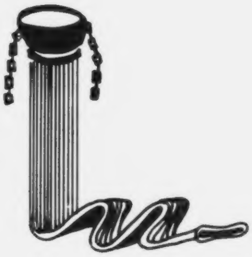
Concrete hopper	Tremie
Concrete chute	Elephant trunk



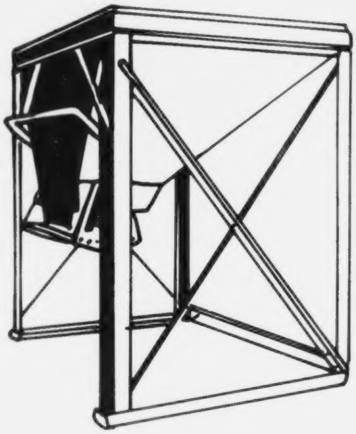
a. ______________________________



b. ______________________________



c. ______________________________

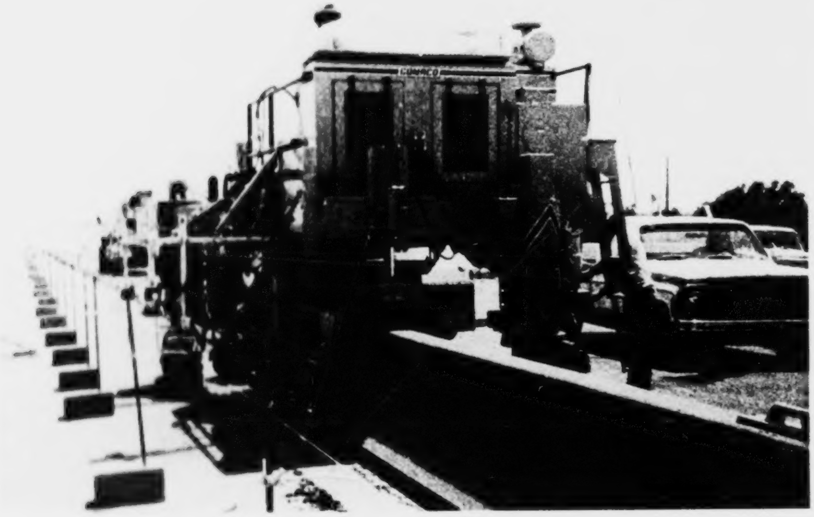


d. ______________________________

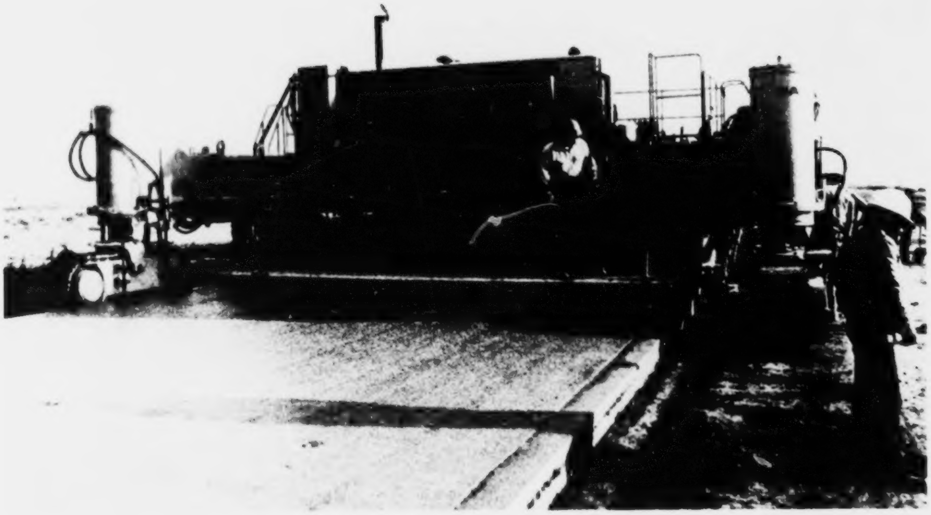
TEST

Pavers

Curb-and-gutter slip-form paver
Slip-form paver
Slope paver (and work bridge and slope conveyor)

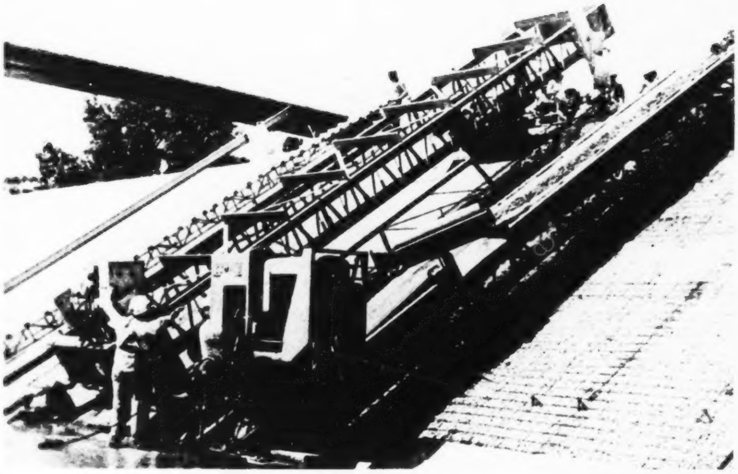


a. ______________________________



b. ______________________________

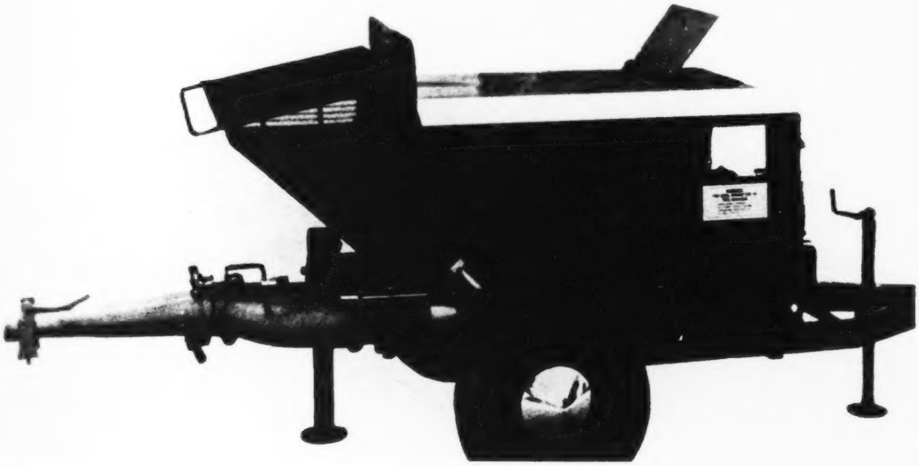
TEST



c. ______________________________

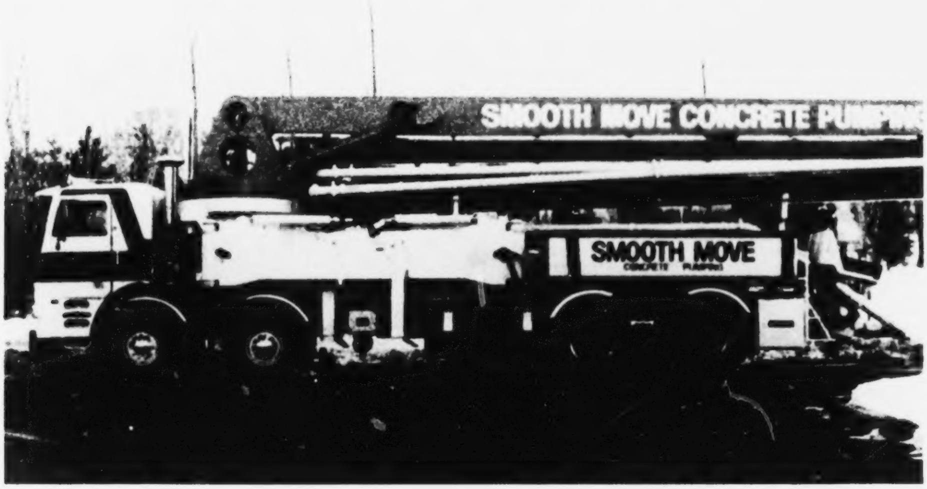
Pumps

Mobile concrete pump (with placing boom)
Portable concrete pump



a. ______________________________

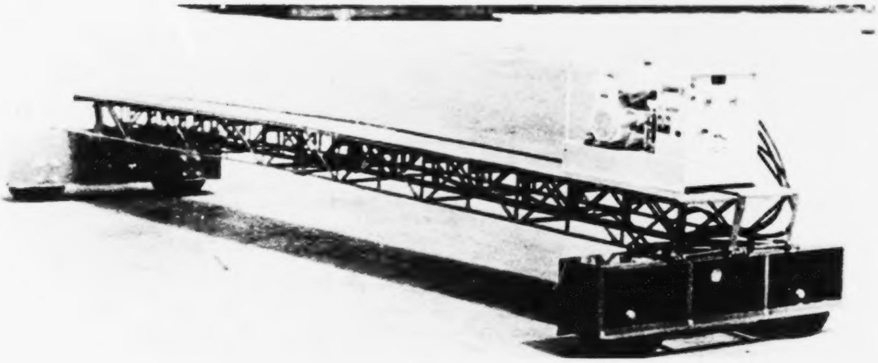
TEST


SMOOTH MOVE CONCRETE PUMPING
SMOOTH MOVE
CONCRETE PUMPING

b. ______________________________

Work bridges

Standard work bridge
Powered work bridge



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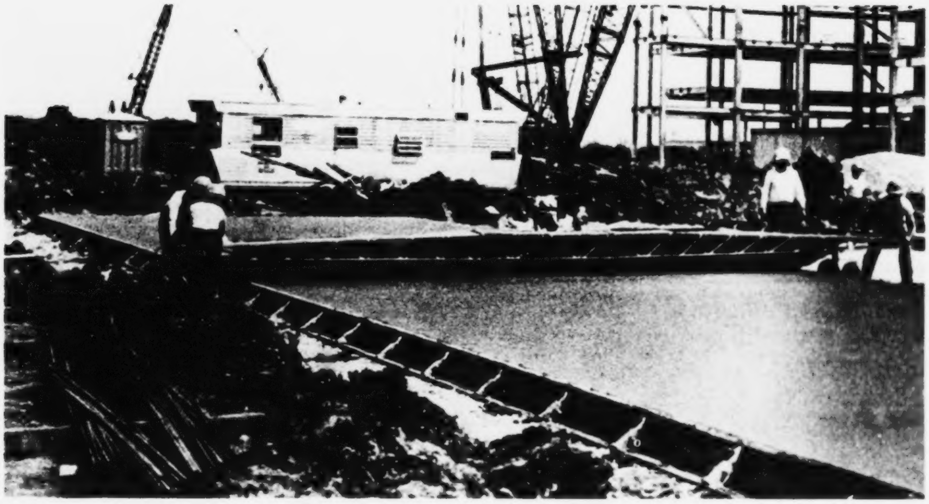
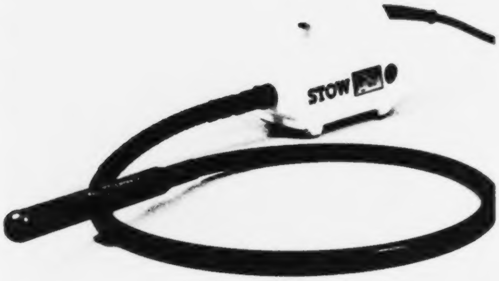
TEST

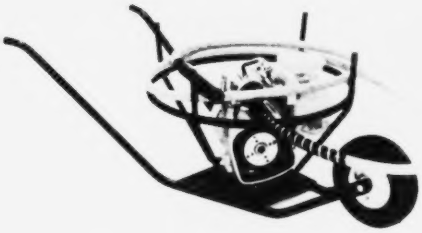


b. ______________________________

Electric vibrators

Lightweight vibrator
Heavy-duty vibrator



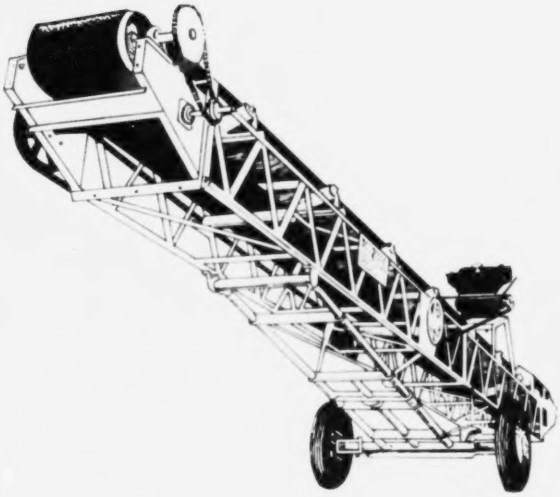


a. ______________________________ b. ______________________________

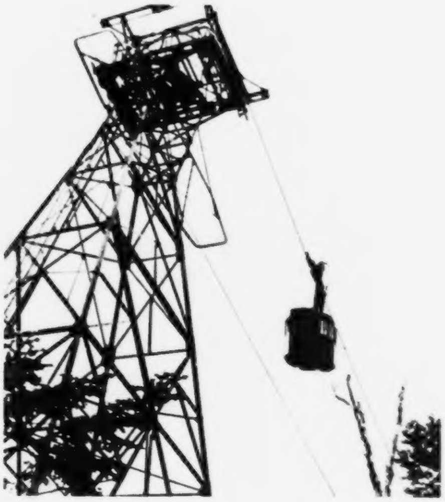
TEST

Miscellaneous transporting and placing equipment

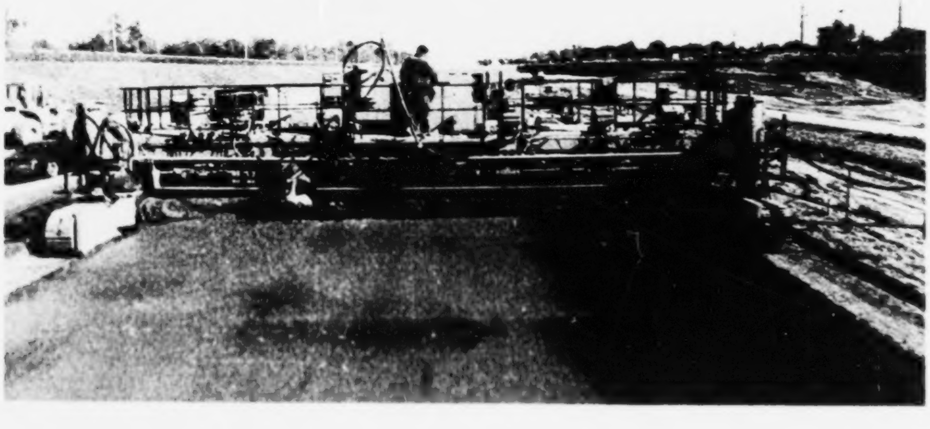
Placing boom	Finishing machine
Placer/spreader	Tramway
Cableway	Conveyor



a. ______________________

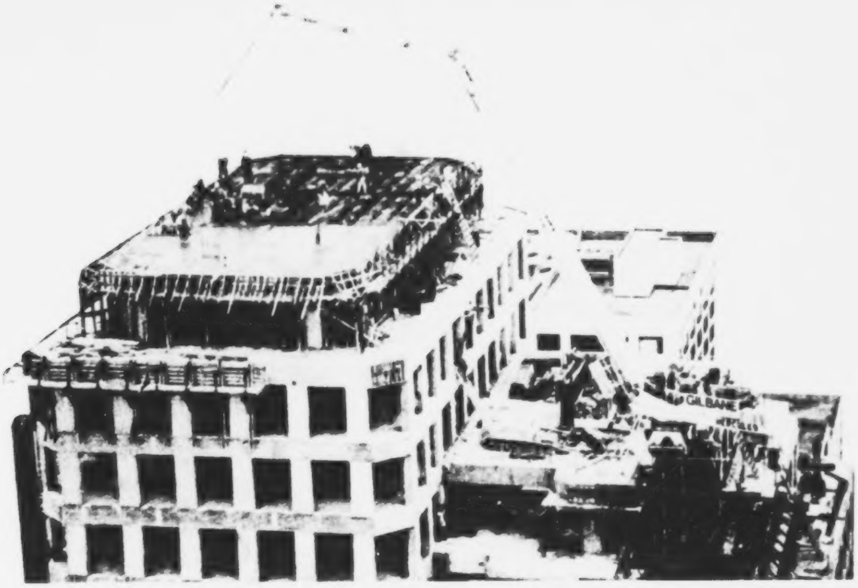


b. ______________________

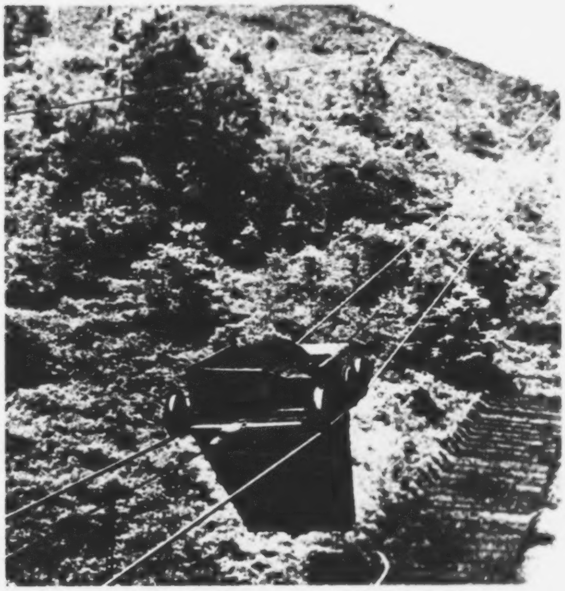


c. ______________________

TEST

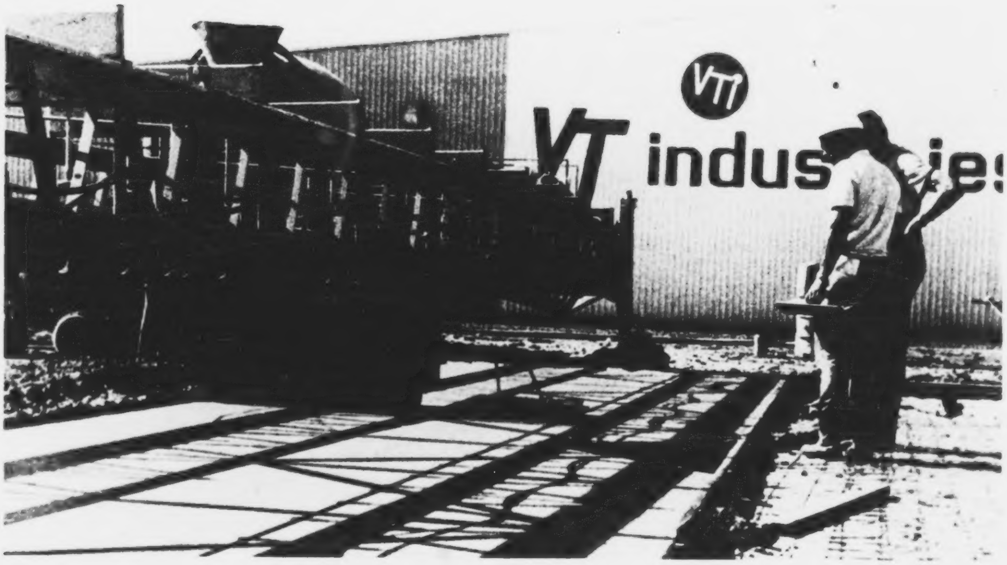


d. ______________________________



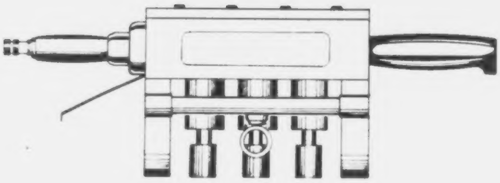
e. ______________________________

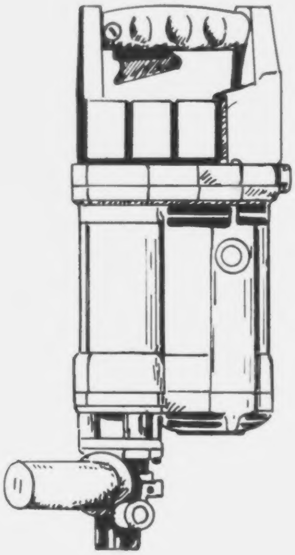
TEST


VTI
VT indus ies

f. ______________________________

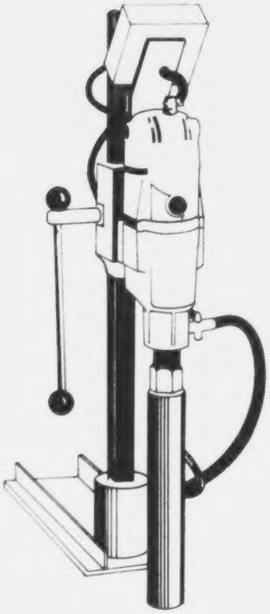
5. Label the following illustrations of equipment used for working with hardened concrete.



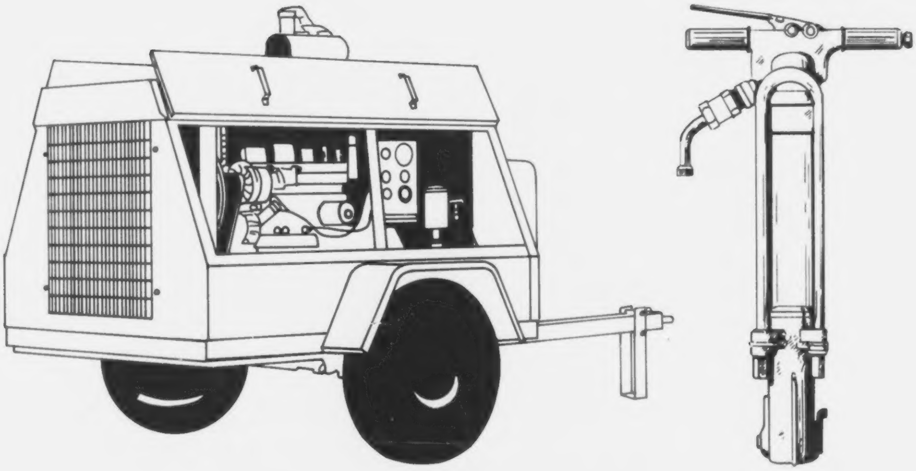


a. ______________________________ b. ______________________________

TEST



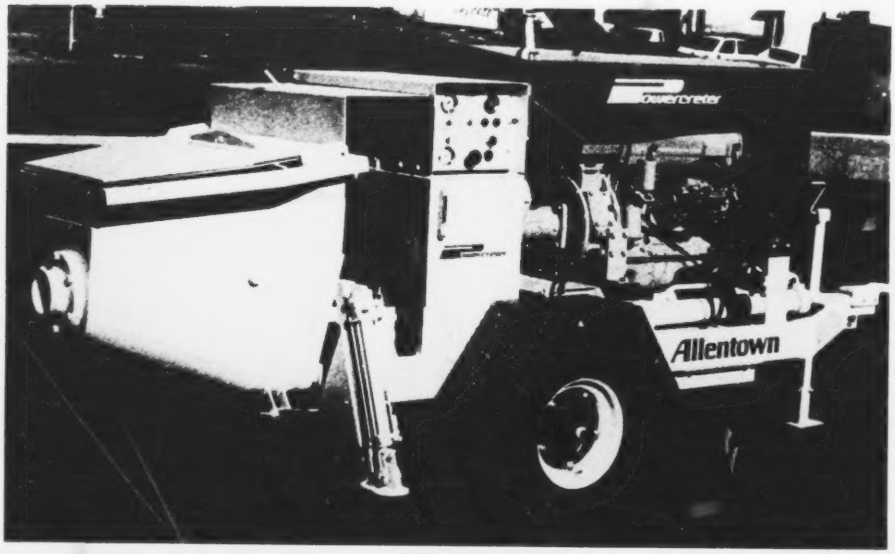
c. ____________________________________



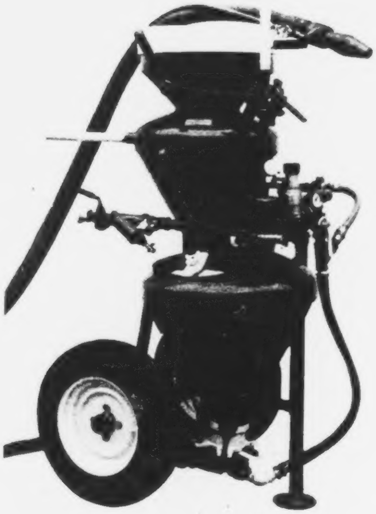
d. ____________________________________

TEST

6. Label the following illustrations of miscellaneous concrete equipment.

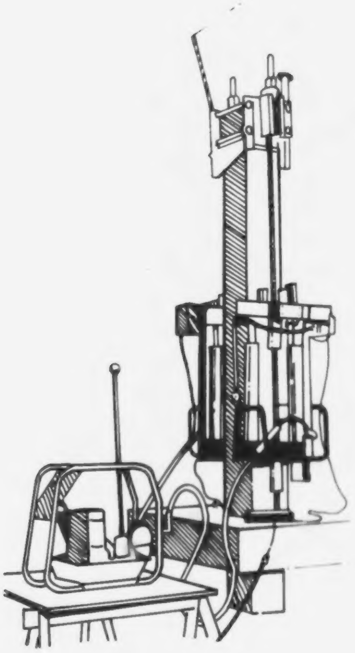

Powercreter
Allentown

a. ______________________________

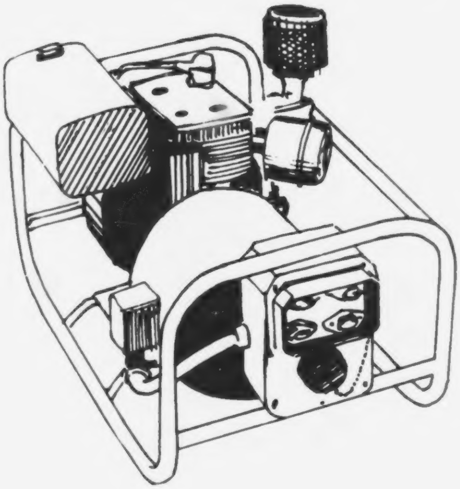


b. ______________________________

TEST

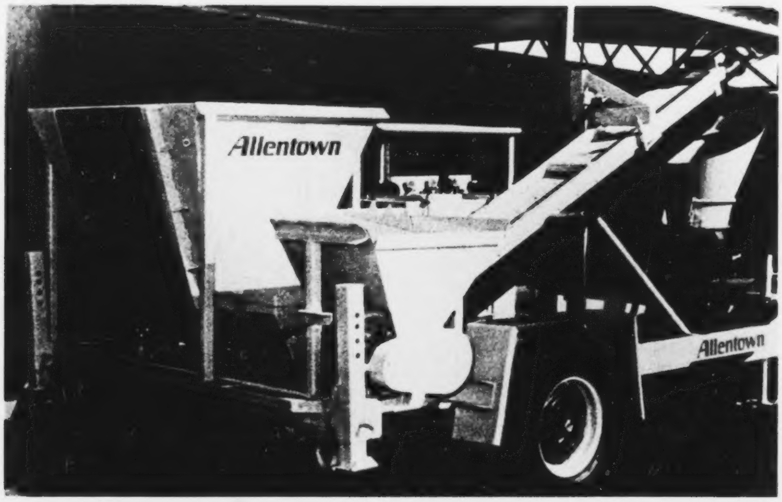


c. ______________________________

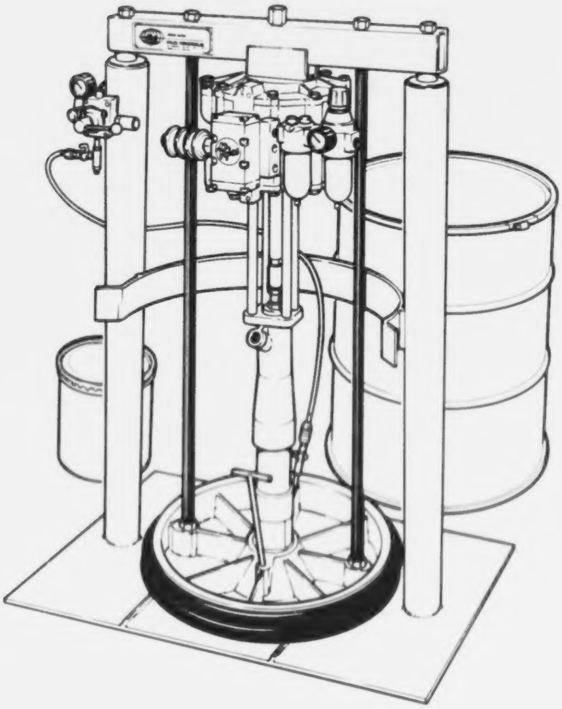


d. ______________________________

TEST

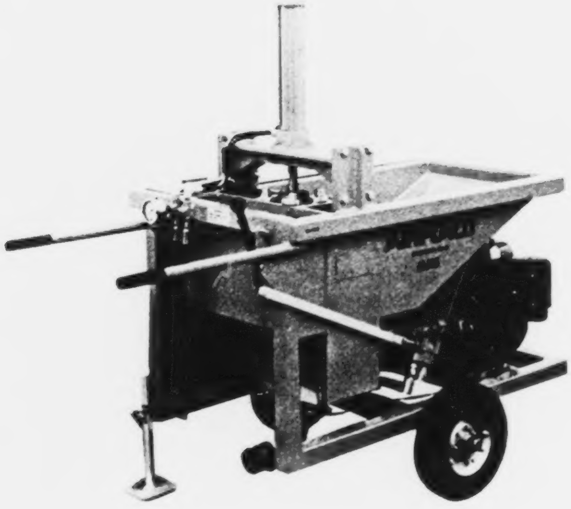

Allentown
Allentown

e. ______________________________

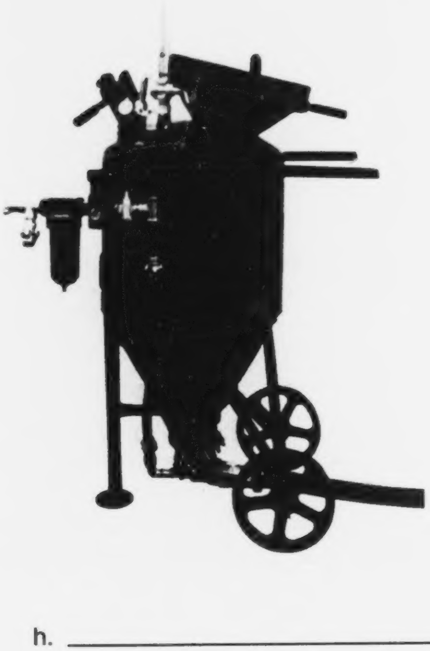


f. ______________________________

TEST



g. ______________________________



h. ______________________________

TEST

7. Match terms and definitions associated with scaffolds and ladders. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

______a. Wheel mounted in a swivel frame and usually furnished with a brake

1. Safety shoe
2. Mudsill
3. Caster

______b. Ladder attached solidly to a structure; usually made of metal and used as a fire escape, roof access, or access to the exterior of tanks and silos

1. Guardrail
2. Fixed ladder
3. Lifeline

______c. Nonslip device attached to bottom of ladder rails

1. Safety shoe
2. Mudsill
3. Caster

______d. Safety rail used on platforms or scaffolds

1. Guardrail
2. Fixed ladder
3. Lifeline

______e. Timber or timber assembly used to keep scaffold legs from sinking into the ground or to protect supporting surface from being damaged by scaffold legs

1. Caster
2. Mudsill
3. Safety shoe

______f. Safety line attached to structure and used by workers to cling to if scaffold should fall

1. Lifeline
2. Mudsill
3. Guardrail

______g. Federal legislation adopted in 1970 to provide safe and healthy workplaces for employees

1. Workmen's Compensation Act (WCA)
2. Safety in the Shop Act (SSA)
3. Occupational Safety and Health Act (OSHA)

TEST

_____h. Manufactured at a factory so that job-site construction consists mainly of assembling standardized parts

1. Job-built
2. Prefabricated
3. Fixed

_____i. Constructed at the job site

1. Job-built
2. Prefabricated
3. Fixed

8. State nine safety rules pertaining to scaffolds.

a. ______________________________

b. ______________________________

c. ______________________________

d. ______________________________

e. ______________________________

f. ______________________________

g. ______________________________

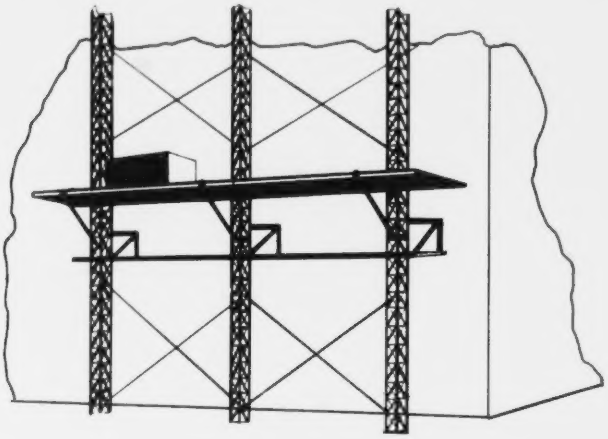
h. ______________________________

i. ______________________________

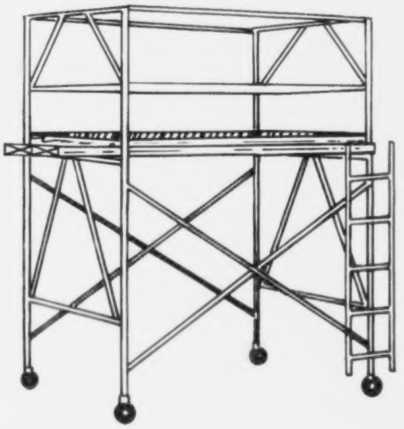
TEST

9. Identify the following illustrations of types of scaffolds. Write the correct names in the blanks.

Tubular, locking-type, prefabricated scaffolding
Metal, rolling, prefabricated scaffolding
Hand-type swing scaffolding
Single-pole job-built scaffolding
Adjustable scaffolding
Scaffold jacks with job-built platform
Power-type swing scaffolding
Double-pole job-built scaffolding

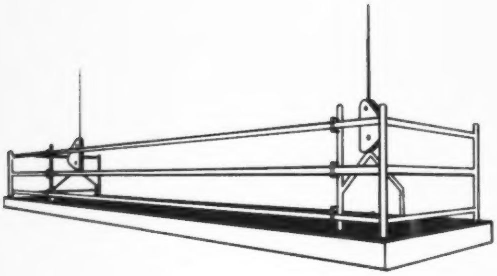


a. ______________________________
____



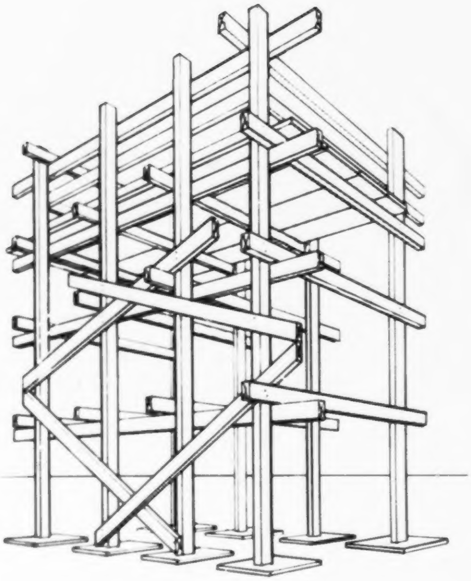
b. ______________________________
____

TEST



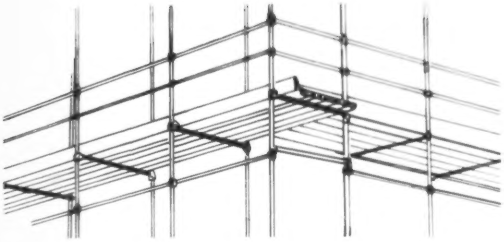
c. ______________________________

____



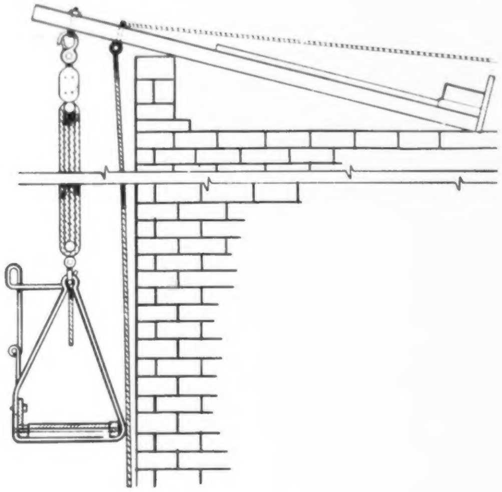
d. ______________________________

____



e. ______________________________

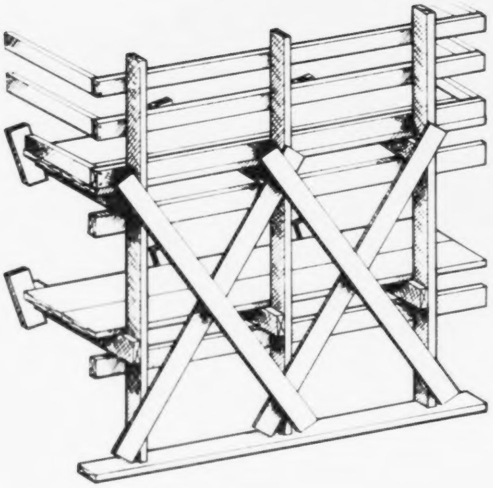
____

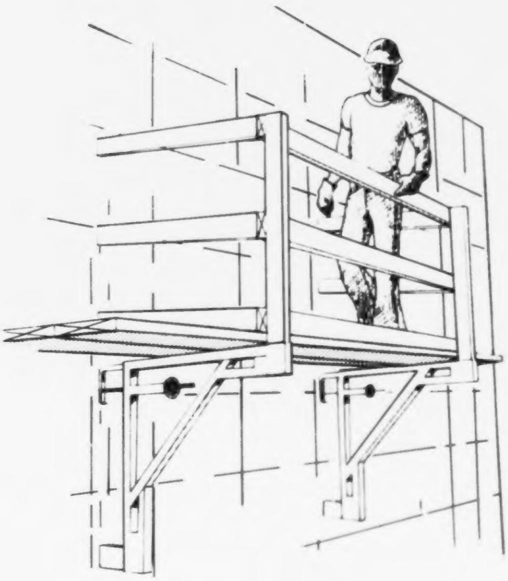


f. ______________________________

____

TEST



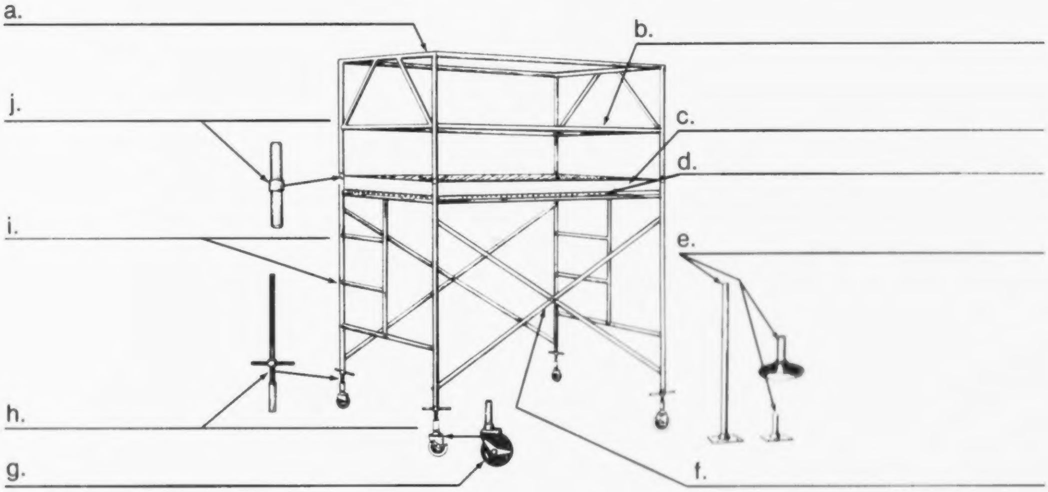


g. ______________________________
____

h. ______________________________
____

10. Identify the parts of the prefabricated rolling scaffolding illustrated below. Write the correct names in the blanks.

End frame
Caster
Base plates
Middle guardrail
Top guardrail
Toeboard
Scaffold planks (platform)
Screw jack
Coupling pin
Crossbrace



TEST

11. State ten safety rules pertaining to ladders.

    a. ______________________________

    b. ______________________________

    c. ______________________________

    d. ______________________________

    e. ______________________________

    f. ______________________________

    g. ______________________________

    h. ______________________________

    i. ______________________________

    j. ______________________________

12. State the safety rule for correct ladder placement.

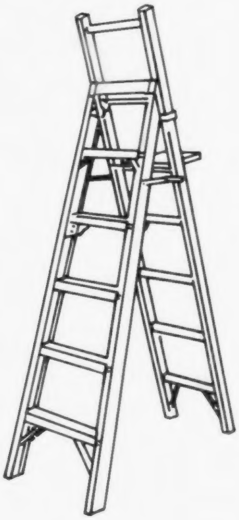
    ____

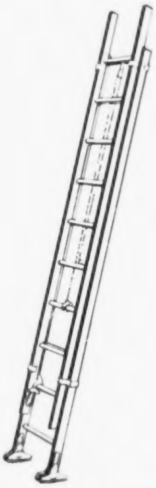
    ____

    ____

    ____

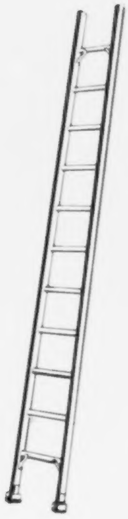
13. Label the following illustrations of types of portable ladders.

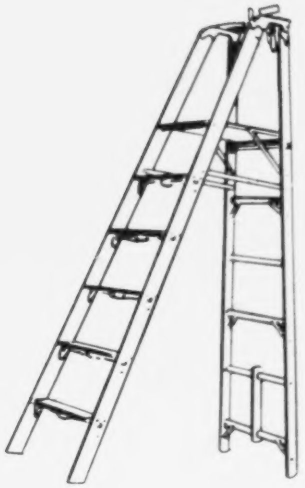




a. ______________________________ b. ______________________________

TEST





c. ______________________ d. ______________________

14. Match terms and definitions associated with rigging. For each of the following definitions, select the best answer from the three terms listed, and then write the correct number in the blank.

_____a.	Short piece of rope, cable, or chain with an eye on each end or an eye on one end and a hook on the other end	1. Shackle 2. Choker 3. Thimble
_____b.	Line used to guide and steady load during hoisting	1. Tag line 2. Bridle 3. Thimble
_____c.	Device used to connect slings, chokers, or chains to loads	1. Thimble 2. Bridle 3. Shackle
_____d.	Grooved metal ring inserted in eye splices to prevent wear	1. Thimble 2. Bridle 3. Shackle
_____e.	Device connected with a threaded pin that goes through one shackle eye and screws into the other eye	1. Choker 2. Screw-pin shackle 3. Thimble
_____f.	Two-legged sling that supports a load at two or more points, or two or more chokers fastened to a common ring	1. Bridle 2. Choker 3. Thimble

TEST

15. State eight safety rules pertaining to rigging.

a. ____________________

b. ____________________

c. ____________________

d. ____________________

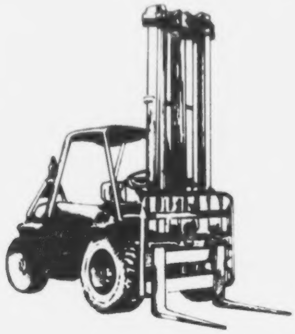
e. ____________________

f. ____________________

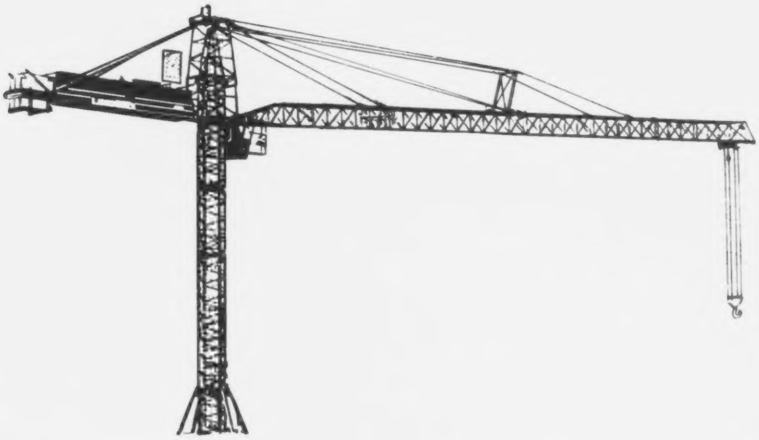
g. ____________________

h. ____________________

16. Label the following illustrations of hoisting and lifting equipment.

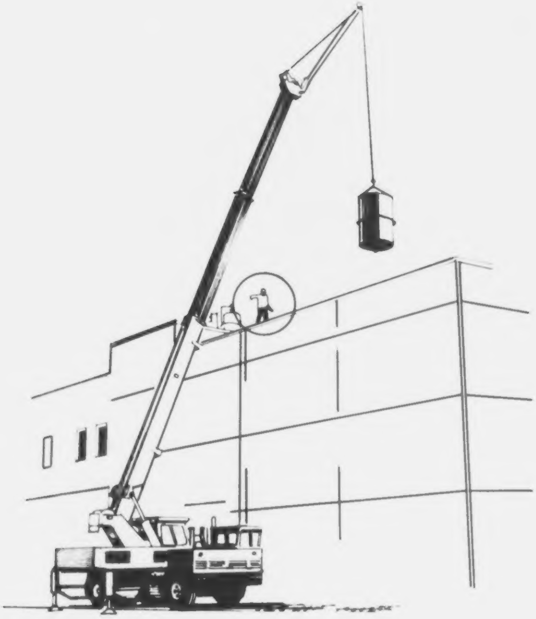


a. ____________________

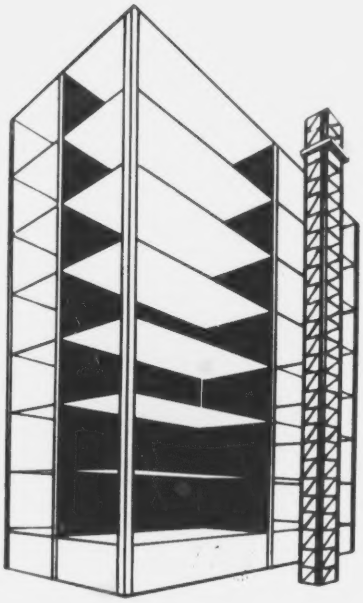


b. ____________________

TEST



c. ____________________________

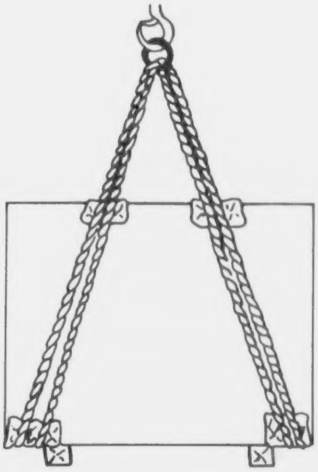


d. ____________________________

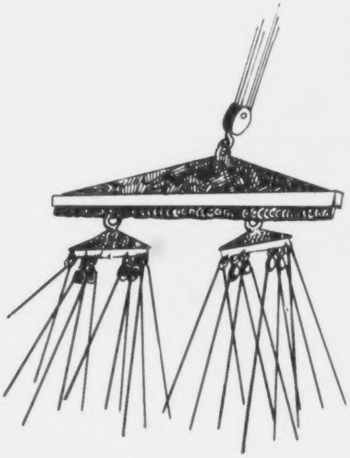
TEST

17. Identify the following illustrations of types of rigging and other devices used for handling panels. Write the correct names in the blanks.

Lewis pin and bridle
Straps (web slings)
Chokers (slings)
Stone clamps
Spreader
Spreader bar
Bridle
Basic edge-lift rigging
Basic two-point-lift rigging
High rigging for approximately equal loads
High rigging modified for panels of various widths

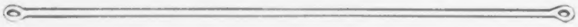


a. ______________________________

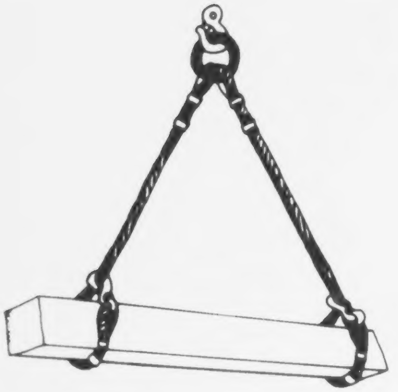


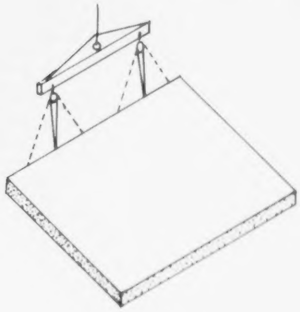
b. ______________________________

TEST

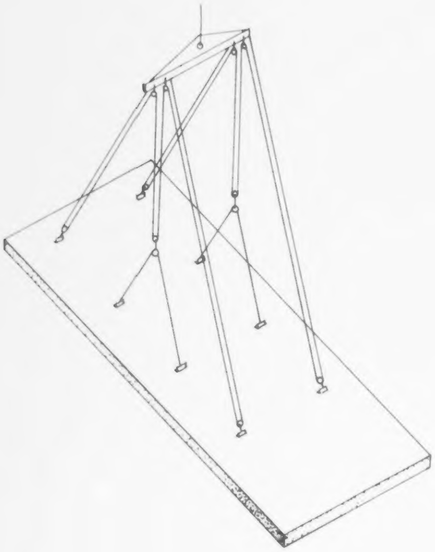


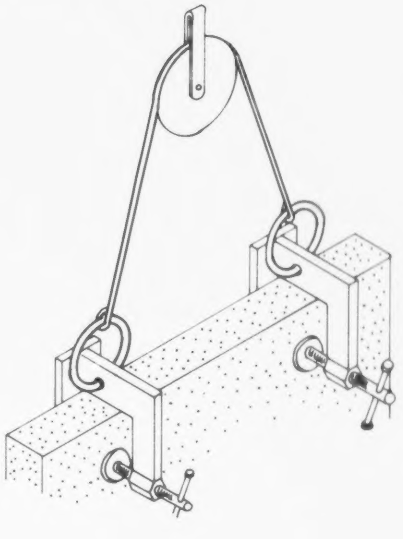
c. ______________________________





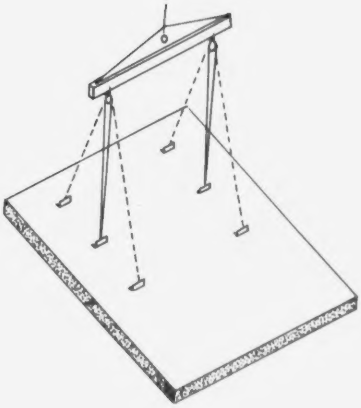
d. ______________________________ e. ______________________________

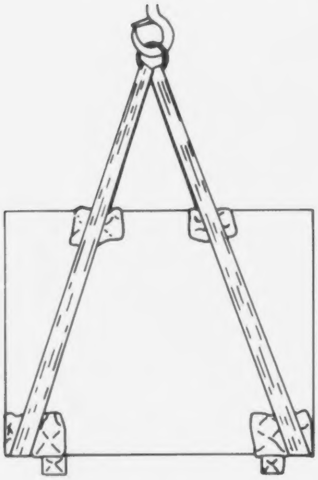




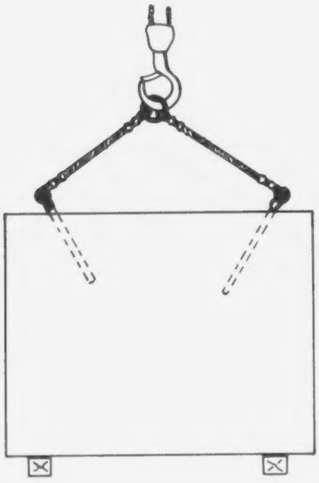
f. ______________________________ g. ______________________________

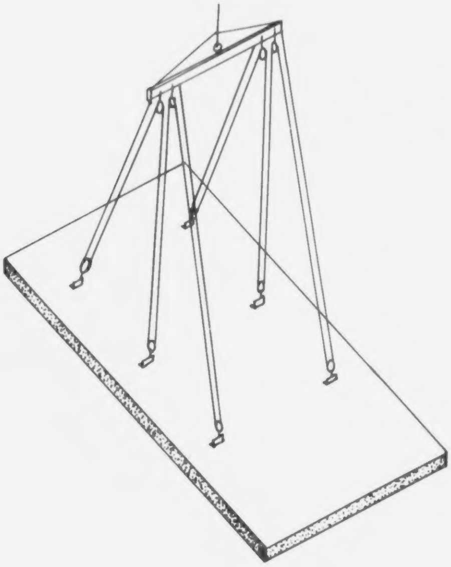
TEST





h. ______________________ i. ______________________





j. ______________________ k. ______________________

TEST

18. State safety rules pertaining to giving hand signals.

a. ____________________

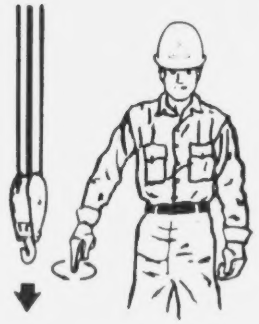
b. ____________________

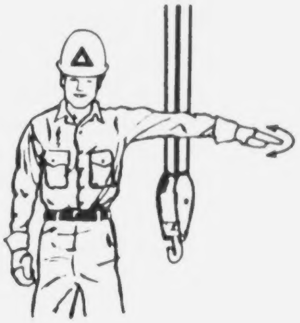
c. ____________________

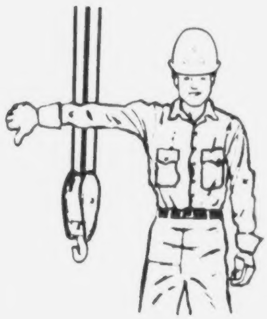
d. ____________________

19. Distinguish among hand signals used in rigging and maneuvering operations. Write an "X" in the blank below each correct illustration.

a. **Lower boom**

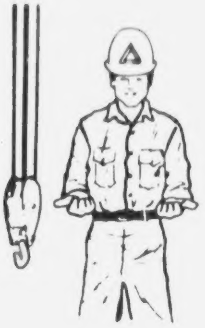


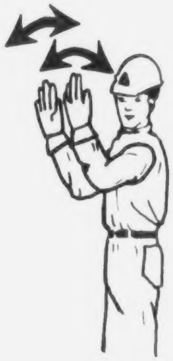


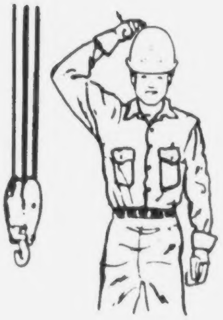


1)____________ 2)____________ 3)____________

b. **Straighten out**



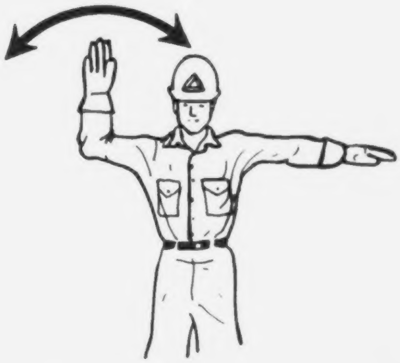


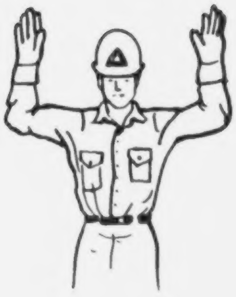


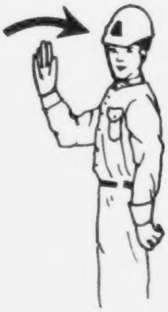
1)____________ 2)____________ 3)____________

TEST

c. **Move backward**

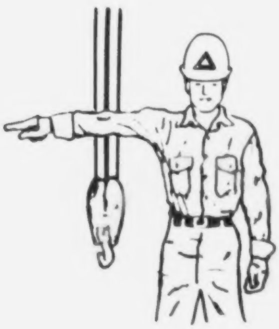


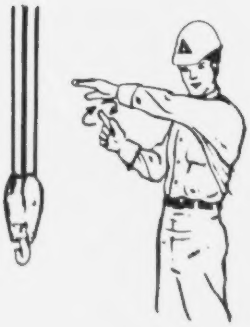


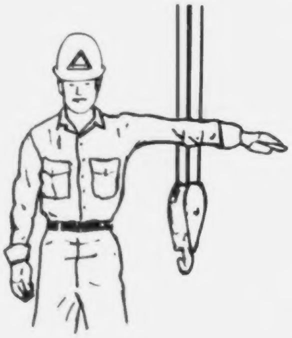


1)______________________ 2)______________________ 3)______________________

d. **Swing**

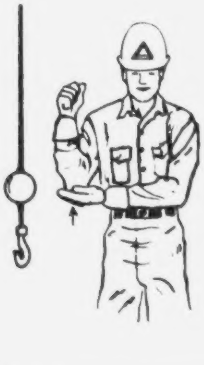


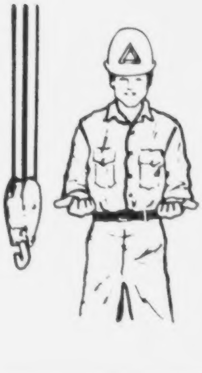


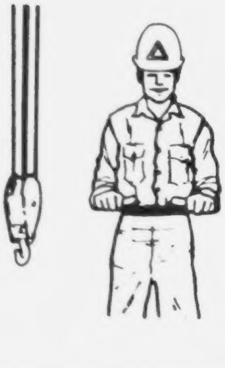


1)______________________ 2)______________________ 3)______________________

e. **Retract boom**



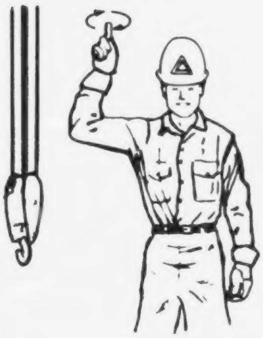


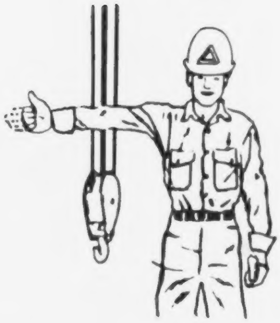


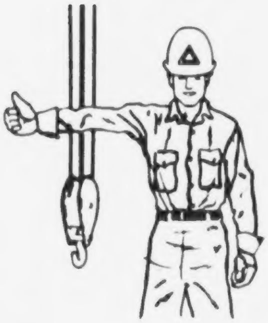
1)______________________ 2)______________________ 3)______________________

TEST

f. **Raise boom**





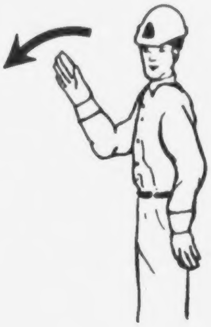


1)____________________ 2)____________________ 3)____________________

g. ______1) Swing in this direction

______2) Move forward

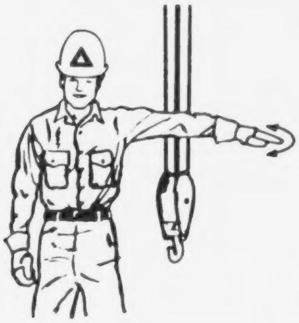
______3) Turn while moving



h. ______1) Swing

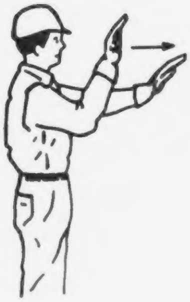
______2) Stop

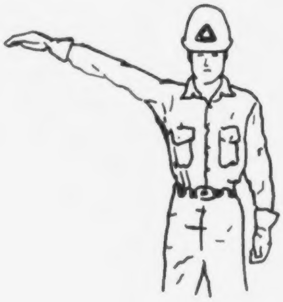
______3) Emergency stop

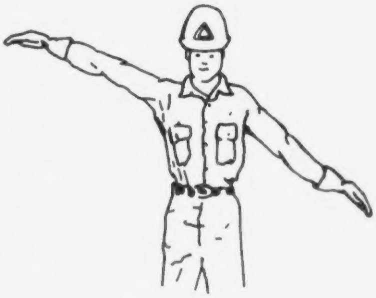


TEST

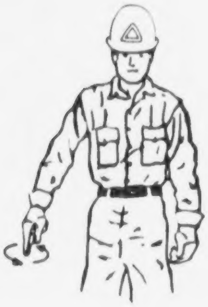
20. Label the following hand signals used in forklift operations. Write the correct names in the blanks.

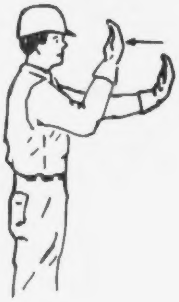


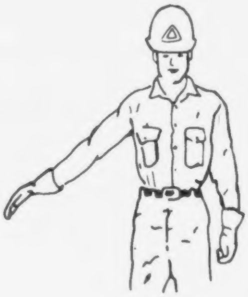




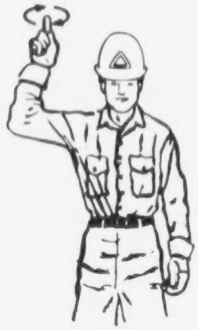
a. ____________________ b. ____________________ c. ____________________

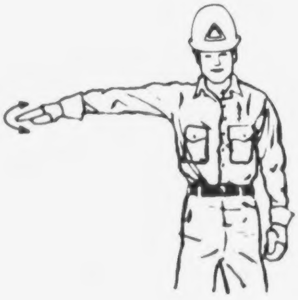


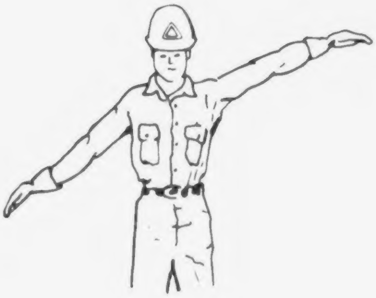




d. ____________________ e. ____________________ f. ____________________







g. ____________________ h. ____________________ i. ____________________

TEST

(NOTE: Test item 21 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

21. Demonstrate the ability to

    a. Set up a section of prefabricated rolling scaffolding.

    b. Rig and handle an extra-long load.

    c. Rig and handle a load to be rotated.

    d. Rig and handle a noncentered load.

MISCELLANEOUS EQUIPMENT
UNIT IV

ANSWERS TO TEST

1. a. 3
   b. 1
   c. 2
   d. 3
   e. 3
   f. 1
   g. 2
   h. 1

2. Answer should include any five of the following.

   a. *Do not* remove safety devices from equipment
   b. Check condition of all equipment before using
   c. Always mark damaged equipment and report any equipment damage to your instructor or supervisor
   d. Exercise extreme caution when moving equipment
   e. Exercise extreme caution when using hoisting equipment
   f. *Do not* attempt to operate equipment before being instructed on its proper use
   g. Wear safety clothing and equipment as required by the job being done
   h. Be sure there is proper ventilation before operating gasoline-powered equipment in an enclosed area
   i. Keep a fire extinguisher handy when operating and filling gasoline-powered equipment

3. a. Concrete batch plant
   b. Mobile (transit) concrete plant
   c. Transit-mix concrete truck

4. **Buggies and wheelbarrows**

   a. Hand buggy
   b. Wheelbarrow
   c. Power buggy

   Hoppers and chutes

   a. Concrete chute
   b. Tremie
   c. Elephant trunk
   d. Concrete hopper

ANSWERS TO TEST

Pavers

a. Curb-and-gutter slip-form paver
b. Slip-form paver
c. Slope paver (and work bridge and slope conveyor)

Pumps

a. Portable concrete pump
b. Mobile concrete pump (with placing boom)

Work bridges

a. Powered work bridge
b. Standard work bridge

Electric vibrators

a. Lightweight vibrator
b. Heavy-duty vibrator

Miscellaneous transporting and placing equipment

a. Conveyor
b. Cableway
c. Placer/spreader
d. Placing boom
e. Tramway
f. Finishing machine

5. a. Scabbler
b. Electric hammer
c. Core drill
d. Air compressor and air-powered hammer

6. a. Shotcrete equipment
b. Sandblasting equipment
c. Lift-slab equipment
d. Generator
e. Gunite machine
f. Joint-sealing equipment
g. Slab-jacking equipment
h. Grouter/placer

7. a. 3
b. 2
c. 1
d. 1
e. 2
f. 1
g. 3
h. 2
i. 1

ANSWERS TO TEST

8. Answer should include any nine of the following.

   a. Check for electrical wires and deenergize any wires in the vicinity before erecting scaffold
   b. Be sure casters are locked before ascending rolling scaffolds
   c. *Do not* work on scaffold during storms, high winds, or when scaffolds are covered with ice or snow
   d. Tie off scaffolds every 25 feet when they are erected several sections high
   e. *Do not* overload scaffolds
   f. Be sure that scaffolds are equipped with toprail, midrail, and toeboard
   g. Use safety belts, harness, and nets as required
   h. *Do not* use bent, broken, or severely rusted scaffold parts
   i. Be sure scaffolds are erected level
   j. Be sure to use mudsills under scaffolds
   k. Be sure scaffold parts used fit the scaffold
   l. When building wood scaffolds, be sure all wood is straight-grained and free of through-knots
   m. *Do not* remove guardrails
   n. *Never* attempt to move a rolling scaffold by yourself
   o. Be sure lifelines on swinging scaffolds are attached to a structural member of the building and not to the scaffold or outrigger
   p. Keep lifeline adjusted to proper height
   q. *Do not* use power swing scaffolds until you have received proper instructions
   r. Familiarize yourself with local, state, and federal safety and health requirements, and be governed accordingly
   s. Know and follow OSHA safety regulations when working on scaffolds

9. a. Adjustable scaffolding
   b. Metal, rolling, prefabricated scaffolding
   c. Power-type swing scaffolding
   d. Double-pole job-built scaffolding
   e. Tubular, locking-type, prefabricated scaffolding
   f. Hand-type swing scaffolding
   g. Single-pole job-built scaffolding
   h. Scaffold jacks with job-built platform

10. a. Top guardrail
    b. Middle guardrail
    c. Toeboard
    d. Scaffold planks (platform)
    e. Base plates
    f. Crossbrace
    g. Caster
    h. Screw jack
    i. End frame
    j. Coupling pin

11. Answer should include any ten of the following.

    a. Fully spread and lock stepladder before using
    b. *Do not* use ladders that are not equipped with safety shoes

ANSWERS TO TEST

c. Always set ladder on firm, level footing
d. Be sure ladder locking mechanisms work
e. Check ladder thoroughly before using
f. *Never* use a ladder near electrical lines
g. Be sure extension and straight ladders are secured at top and bottom
h. *Never* work from the top step of a ladder
i. *Never* overreach from a ladder
j. Be sure your shoe soles and the ladder rungs are clean and free of grease and mud
k. *Never* allow more than one person to work on a ladder
l. *Never* use an extension ladder that is overlapped less than 3 feet
m. *Never* move a 12-foot or longer ladder by yourself; get assistance
n. *Never* set a ladder in front of a doorway, aisle, or driveway without securing the area or having someone stand guard
o. Use both hands when going up or down a ladder
p. *Never* carry tools in your hands when climbing a ladder
q. Use safety equipment when working on or using a fixed ladder
r. Be sure job-built ladders are built according to OSHA regulations
s. *Never* use a ladder placed in horizontal position
t. Remove a ladder when you have finished using it, and always remove and store ladder at end of workday
u. Secure ladder at both top and bottom to prevent displacement; brace long ladder at intermediate points to prevent spring
v. Familiarize yourself with local, state, and federal safety requirements and be governed accordingly

12. Place ladder approximately one-quarter of its support length away from vertical plane of top support, and extend ladder at least 3 feet above top support

13. a. Combination ladder
b. Extension ladder
c. Single, straight ladder
d. Stepladder

14. a. 2
b. 1
c. 3
d. 1
e. 2
f. 1

15. Answer should include any eight of the following.

a. Turn hooks out
b. Use shackles on chokers where there may be cutting action
c. Pad all sharp corners and edges
d. Always make vertical lifts on eyebolts
e. Use thimble in eye splices
f. Use a shackle whenever two or more ropes are to be used over a hook
g. Use tag lines to control loads
h. Secure all unused sling lines

ANSWERS TO TEST

i. *Never* wrap a rope around a hook
j. *Do not* permit bending of rope near a splice or attached fitting
k. Block all loads properly before unhooking
l. *Never* allow a shackle to be pulled at an angle
m. *Do not* use a screw-pin shackle if the pin can roll under load and unscrew
n. Center crane over load before lifting
o. Keep machines at least 10 feet from all electrical equipment
p. For proper sling angle, be sure that length of sling (L) is always greater than span (S) between the two connections

16. a. Forklift
b. Tower crane
c. Mobile crane and bucket
d. Materials-handling tower hoist

17. a. Choker (slings)
b. Spreader bar
c. Spreader
d. Bridle
e. Basic edge-lift rigging
f. High rigging for approximately equal loads
g. Stone clamps
h. Basic two-point-lift rigging
i. Straps (web slings)
j. Lewis pins and bridle
k. High rigging modified for panels of various widths

18. a. Only one person gives hand signals
b. Give all hand signals clearly
c. Make sure the equipment operator can see you and is able to acknowledge the signal given
d. Before beginning hoisting procedure, warn other workers to stay clear of the hoisting area; *never* raise or lower load over other workers

19. a. 3
b. 2
c. 3
d. 1
e. 3
f. 3
g. 2
h. 3

20. a. Move load backward
b. Tilt forks up
c. Tilt forks right
d. Lower load
e. Move load forward
f. Tilt forks down
g. Raise load
h. Stop
i. Tilt forks left

21. Performance skills evaluated to the satisfaction of the instructor.

LEVELING INSTRUMENTS
UNIT V

UNIT OBJECTIVE

After completing this unit, the student should be able to set up and use common leveling instruments. The student will show this ability by completing the job sheets and unit test with a minimum score of 85 percent.

SPECIFIC OBJECTIVES

After completing this unit, the student should be able to

1. Select correct definitions of terms associated with leveling instruments.
2. List uses of leveling instruments.
3. Identify types of leveling instruments.
4. Identify parts of a builder's level.
5. Label vertical and horizontal cross hairs and line of sight on a leveling instrument.
6. State rules for proper care of leveling instruments.
7. Identify parts of a leveling rod.
8. Match parts of a leveling rod to their correct uses.
9. Describe commonly used direct-reading rods.
10. Read direct-reading rods.
11. Calculate differences in elevations when performing differential leveling.
12. Identify hand signals used by the instrument person to guide the rod person.
13. Demonstrate the ability to
    a. Set up and adjust a tripod and builder's level.
    b. Use a builder's level to check footing elevations.
    c. Use a builder's level to perform differential leveling.
    d. Connect a plumb bob to an instrument.
    e. Set up and adjust a combination level-transit.
    f. Use a combination level-transit to locate building-line points on batter boards.

LEVELING INSTRUMENTS
UNIT V

SUGGESTED ACTIVITIES

I. Unit contents

   A. Objective sheet

   B. Suggested activities

   C. Transparency masters

      1. TM #1 — Reading a Leveling Rod Graduated in Eighths of an Inch

      2. TM #2 — Reading a Leveling Rod Graduated in Hundredths of a Foot

      3. TM #3 — Field Book

   D. Information sheet

   E. Assignment sheets

      1. Assignment Sheet #1 — Read Leveling Rods

      2. Assignment Sheet #2 — Calculate Differences in Elevations

      3. Assignment Sheet #3 — Distinguish Among Hand Signals Used by the Instrument Person to Guide the Rod Person

   F. Answers to assignment sheets

   G. Job sheets

      1. Job Sheet #1 — Set Up and Adjust a Tripod and a Builder's Level

      2. Job Sheet #2 — Use a Builder's Level to Check Footing Elevations

      3. Job Sheet #3 — Use a Builder's Level to Perform Differential Leveling

      4. Job Sheet #4 — Connect Plumb Bob to an Instrument

      5. Job Sheet #5 — Set Up and Adjust a Combination Level-Transit

      6. Job Sheet #6 — Use a Combination Level-Transit to Locate Building-Line Points on Batter Boards

   H. Test

   I. Answers to test

SUGGESTED ACTIVITIES

II. Instructor's guide

A. Review unit and plan presentation.

1. Review Job Sheet #2, "Use a Builder's Level to Check Footing Elevations." You will need to locate a site and arrange practice elevations on footings as shown in the drawing accompanying the job sheet, or you may prefer to assign other practice elevations and to have the job performed on a shop floor or on a parking lot.

2. Review Job Sheet #3, "Use a Builder's Level to Perform Differential Leveling." You will need to locate a site and arrange practice elevations as shown in the drawing accompanying the job sheet, or you may prefer to assign other practice elevations.

B. Obtain materials to supplement unit.

1. Transparencies and competency profiles

(NOTE: Transparencies and competency profiles for this book are available from the Oklahoma State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, Oklahoma 74074, or from The Associated General Contractors of America, 1957 E Street, N.W., Washington, D.C. 20006, phone 202-393-2040.)

2. Filmstrips

(NOTE: The following color filmstrips come with a manual and may be ordered from the California State Polytechnic University, San Luis Obispo, California 93407.)

a. *Setting Up the Instrument*

b. *Reading the Rod*

c. *Exercise in Differential Leveling*

3. Copies of the warning included in laser-beam-instrument literature

C. Introduce unit.

SUGGESTIONS:

- Invite an instrument salesperson or a surveyor to display and discuss the cost, use, and proper care of the various types of leveling instruments.
- Visit a construction site to let the students observe leveling instruments in use.
- Explain to students that the instruments are relatively easy to use; but emphasize that the instruments must be used carefully and skillfully in order to get accurate readings.

SUGGESTED ACTIVITIES

D. Provide students with objective sheet.

E. Discuss unit and specific objectives.

F. Provide students with information, assignment, and job sheets.

G. Discuss information, assignment, and job sheets.

1. Use Information Sheet, Section I, to discuss terms and definitions associated with leveling instruments.

   SUGGESTIONS:

   - Show students actual instruments—a builder's level, laser-beam instrument, and transit—and examples of other objects used with the instruments—field book, leveling rod, grade stake, and plumb bob.
   - Take the students to a construction site to demonstrate shooting-grade concepts such as slope, elevation, fall, bench mark, finish-floor height, grade line, etc.
   - Set up a level, and have students look through the telescope to reinforce your discussion of cross hairs and line of sight.

2. Use Information Sheet, Section II, to discuss uses of leveling instruments.

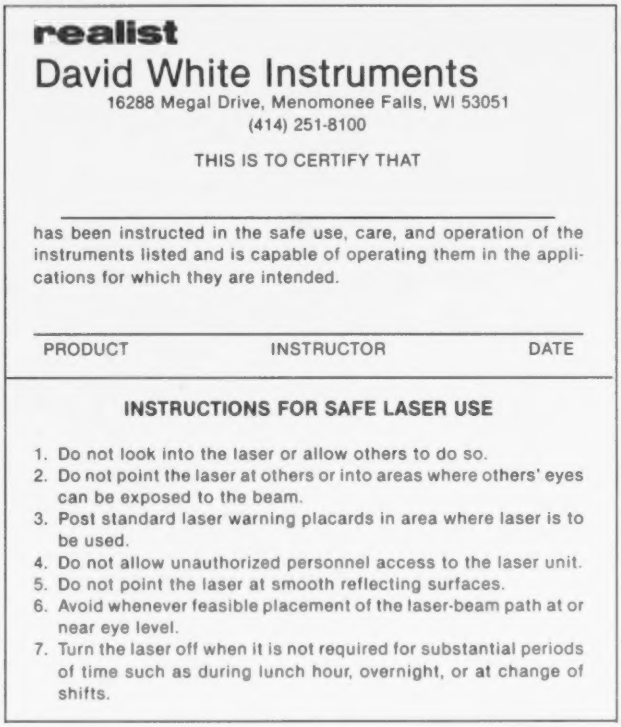
3. Use Information Sheet, Sections III and IV, to discuss types of leveling instruments and the parts of a builder's level.

   SUGGESTIONS:

   - Show students examples of the various types of levels illustrated in the information sheet. Point out the various parts of the levels and demonstrate all movements of the instruments.
   - Discuss the uses of the various types of levels, emphasizing the possible advantages and disadvantages of each type.
   - Explain to students that the automatic level and the laser-beam instrument are the types of levels that they will see being used on large construction jobs; however, the builder's level and the combination level-transit are the two types that they will be most likely to use themselves.
   - Explain that a certification card must be earned before a person can use a laser-beam instrument. Also explain that government regulations require a warning to be included on literature concerning laser-beam-instrument use.
   - Hand out copies of the certification card/warning on the next page and discuss with the class.

SUGGESTED ACTIVITIES

EXAMPLE:



realist

David White Instruments

16288 Megal Drive, Menomonee Falls, WI 53051
(414) 251-8100

THIS IS TO CERTIFY THAT

____

has been instructed in the safe use, care, and operation of the instruments listed and is capable of operating them in the applications for which they are intended.

____

PRODUCT INSTRUCTOR DATE

INSTRUCTIONS FOR SAFE LASER USE

1. Do not look into the laser or allow others to do so.
2. Do not point the laser at others or into areas where others' eyes can be exposed to the beam.
3. Post standard laser warning placards in area where laser is to be used.
4. Do not allow unauthorized personnel access to the laser unit.
5. Do not point the laser at smooth reflecting surfaces.
6. Avoid whenever feasible placement of the laser-beam path at or near eye level.
7. Turn the laser off when it is not required for substantial periods of time such as during lunch hour, overnight, or at change of shifts.

Used with permission of the David White Instrument Division of Realist, Inc., Menomonee Falls, Wisconsin.

- Set up a builder's level, point out the parts of the level illustrated in the information sheet, and demonstrate all movements of the instrument.

4. Use Information Sheet, Section V, to discuss vertical and horizontal cross hairs and line of sight on a leveling instrument.

SUGGESTION:

- Set up various leveling instruments and allow students to sight through each instrument to identify vertical and horizontal cross hairs and to locate line of sight.

5. Use Information Sheet, Section VI, to discuss the rules for proper care of leveling instruments.

SUGGESTIONS:

- Discuss the cost of leveling instruments and emphasize that they must be handled with care.
- Show the filmstrip *Setting Up the Instrument*.

SUGGESTED ACTIVITIES

- Demonstrate to students the proper procedure for removing levels from their carrying cases and for setting up the instruments; acquaint students with your rules for student use of these instruments.
- Have students complete Job Sheet #1, "Set Up and Adjust a Tripod and a Builder's Level."
- Demonstrate to students the proper procedures for attaching a plumb bob to the instruments.
- Explain to the students that for accuracy a leveling instrument should be set as close as possible to a point equidistance from all points.
- Have students complete Job Sheets #4 and #5.

6. Use Information Sheet, Sections VII and VIII, to discuss the parts of a leveling rod and their correct uses.

   SUGGESTION:

   - Use an actual rod to point out the parts illustrated in the information sheet and to demonstrate the correct use of each part.

7. Use Information Sheet, Section IX, to discuss commonly used direct-reading rods.

   SUGGESTIONS:

   - Show the students an example of each type of direct-reading rod and discuss when it is more appropriate to use one or the other.
   - Show the filmstrip *Reading the Rod*.

8. Use Information Sheet, Sections X and XI, to discuss reading a direct-reading rod and calculating differences in elevations when performing differential leveling.

   SUGGESTIONS:

   - Use Transparencies #1 through #3 to illustrate information presented in these sections of the information sheet.
   - Have students practice reading a direct-reading rod and calculating differences in elevations by completing Assignment Sheets #1 and #2.
   - Show film strip *Exercise in Differential Leveling*.

SUGGESTED ACTIVITIES

9. Use Information Sheet, Section XII, to discuss hand signals used by the instrument person to guide the rod person.

   SUGGESTIONS:

   - Demonstrate each of the hand signals illustrated in the information sheet.
   - Have students practice recognizing hand signals by completing Assignment Sheet #3, "Distinguish Among Hand Signals Used by the Instrument Person to Guide the Rod Person."
   - Allow the students to practice giving the signals to each other in the shop or in the field.

10. Have students review material presented in Information Sheet, Sections V through VII, and then divide class into teams of two to complete Job Sheets #2, #3, and #6.

H. Review information.

I. Give test.

J. Critique test and discuss in class.

K. Complete appropriate section of competency profiles.

III. Unit references

A. Blount Electronic Instruments. *Product Information Folder*. North Little Rock, Arkansas: Blount Electronic Instruments, n.d.

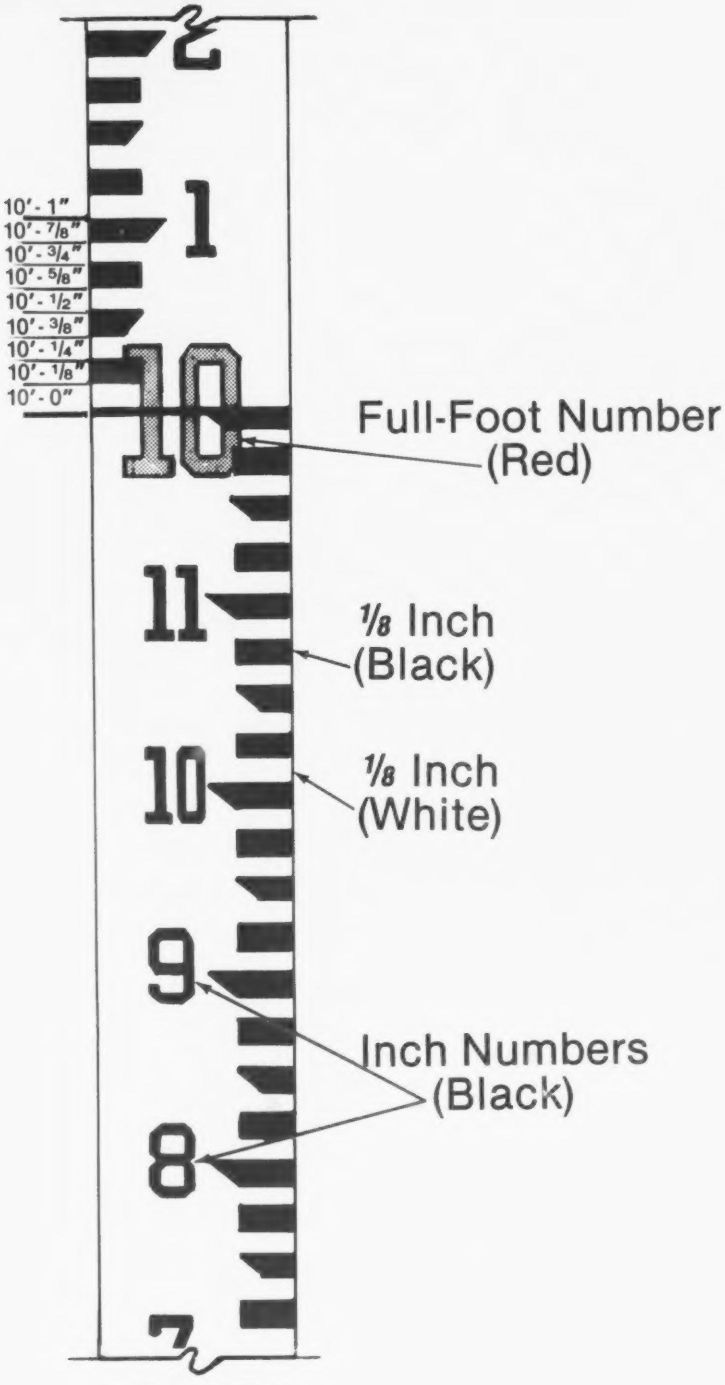
B. *Builders/Contractors Instruments.* Menomonee Falls, Wisconsin: David White Instruments Division of Realist, Inc., n.d.

C. Hendrix, Laborn J. "Bud." *Bricklaying Curriculum*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1983.

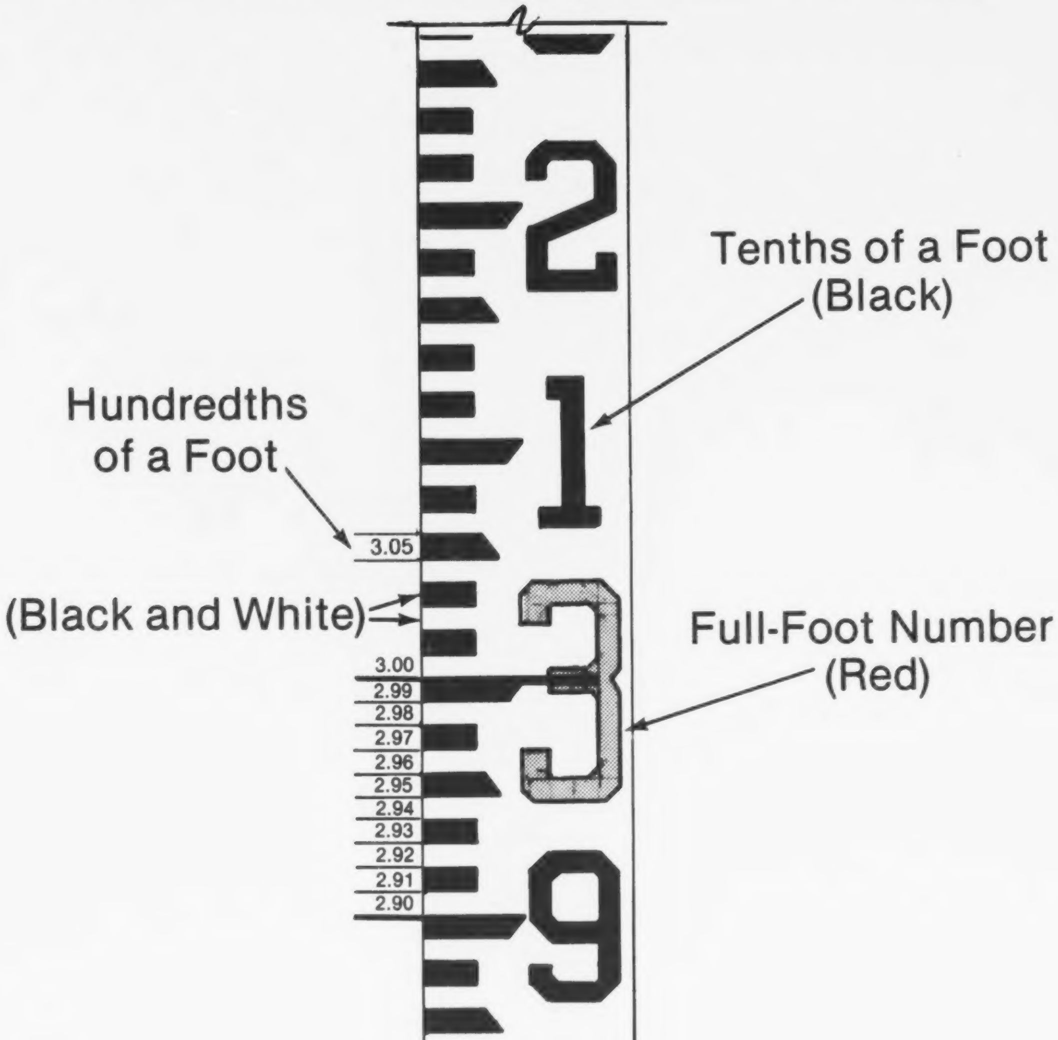
D. Hendrix, Laborn J. "Bud." *Fundamentals of Carpentry*. Stillwater, Oklahoma: State Department of Vocational and Technical Education/Curriculum and Instructional Materials Center, and The Associated General Contractors of America, 1985.

E. Kissam, Philip. *Surveying Practice*, 2nd ed. New York: McGraw-Hill Book Company, 1971.

Reading a Leveling Rod Graduated in Eighths of an Inch

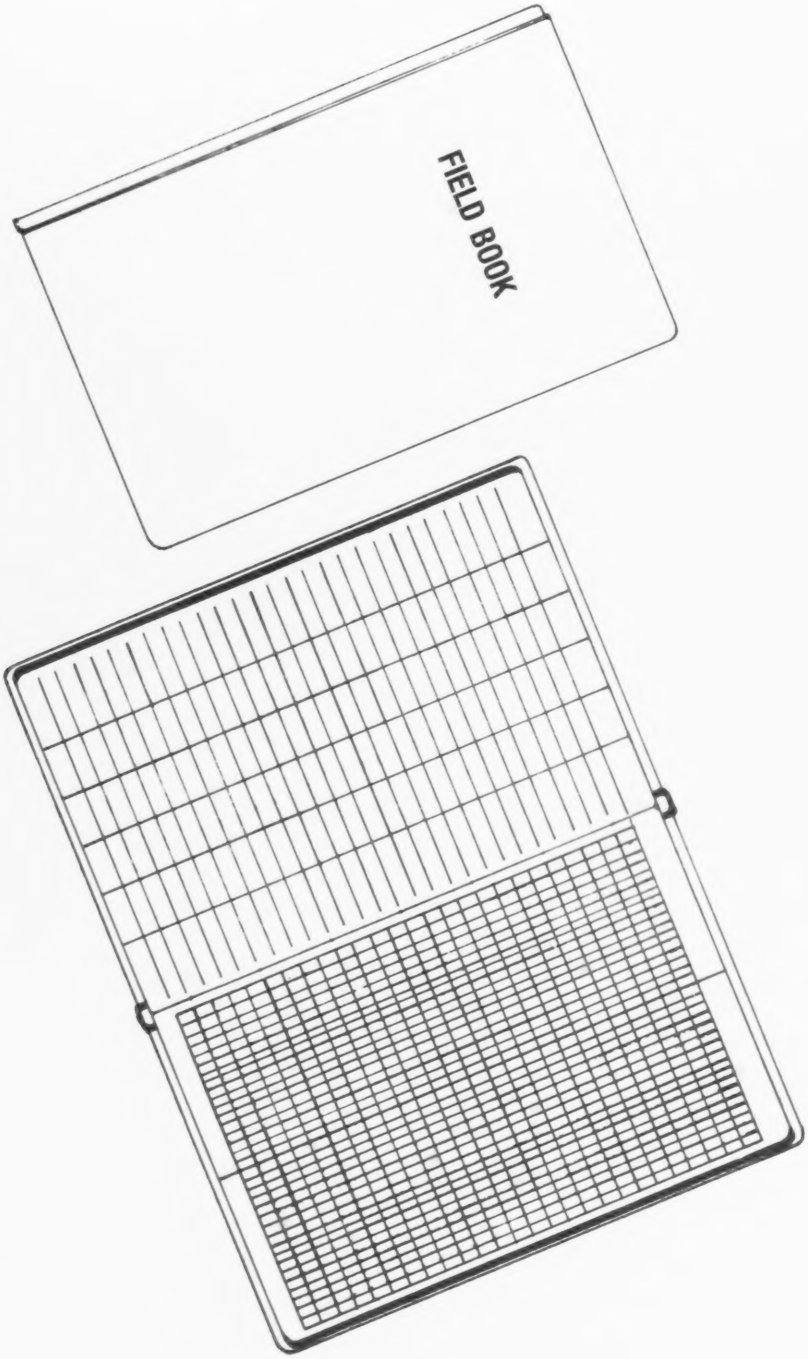

2
1
10'- 1"
10'- 7/8"
10'- 3/4"
10'- 5/8"
10'- 1/2"
10'- 3/8"
10'- 1/4"
10'- 1/8"
10'- 0"
10
Full-Foot Number (Red)
11
1/8 Inch (Black)
10
1/8 Inch (White)
9
Inch Numbers (Black)
8
7

Reading a Leveling Rod Graduated in Hundredths of a Foot


2
Tenths of a Foot
(Black)
1
Hundredths
of a Foot
3.05
(Black and White)
3
Full-Foot Number
(Red)
3.00
2.99
2.98
2.97
2.96
2.95
2.94
2.93
2.92
2.91
2.90
9
8

FCCM - 327-D

FIELD BOOK



1037

TM #3

LEVELING INSTRUMENTS
UNIT V

INFORMATION SHEET

I. Terms and definitions associated with leveling instruments

A. Builder's level — Instrument consisting of a telescope and leveling bubble; used with a tripod and leveling rod primarily for establishing grade levels

B. Bench mark (BM) — Permanent point of known or assumed elevation

(NOTE: A specific point on a curb or culvert is sometimes used as a bench mark.)

C. Cross hairs — Fine horizontal and vertical lines in telescope barrel of leveling instrument; used as a reference line in the field or for marking instrumental axis

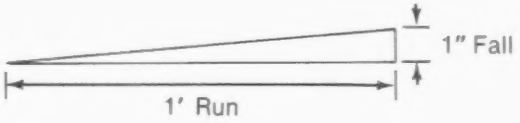
D. Differential leveling — Method by which the difference in elevation between two points is determined by plus and minus rod readings that are totaled and adjusted to bench mark

E. Elevation — Given grade

F. Fall — Slope of a line, usually given in inches per foot

EXAMPLE: One-inch fall per 1 foot of run (Figure 1)

FIGURE 1



G. Field book — Small book used to record instrument readings for layout and elevations of proposed structures

H. Finish-floor height — Elevation of finished floor in relation to bench mark

I. Grade line — Proposed or future level of ground at construction line

J. Grade stake — Stake driven into ground at proposed grade

(NOTE: The grade stake is read from the bench mark.)

K. Height of instrument (HI) — Vertical distance from bench mark to line of sight of leveling instrument

INFORMATION SHEET

L. Laser-beam instrument — Automatic leveling instrument that uses a laser beam to establish elevation readings

M. Leveling rod — Rod with markings graduated upward from zero; used with leveling instrument to determine elevations

N. Plumb bob — Tool or device attached to a string; used to set and check vertical or perpendicular of a surface

O. Site — Plot of ground on which a project is to be constructed

P. Surveying — Art or science of determining area and configuration of portions of earth's surface with a minimum of accuracy

Q. Temporary bench mark (TBM) — Elevation reference point used when permanent point is not in sight

R. Perpendicular — Exactly upright; at a right angle (90-degree angle) to another line or surface

II. Uses of leveling instruments

A. Establishing elevations and grades

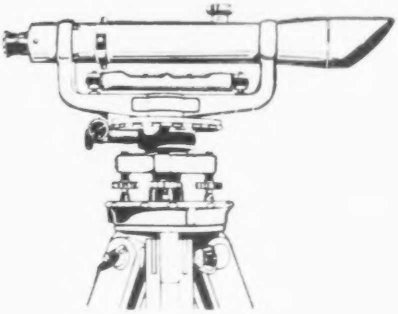
B. Establishing differential elevations

C. Transferring elevations from one point to another

III. Types of leveling instruments (Figures 2 - 9)

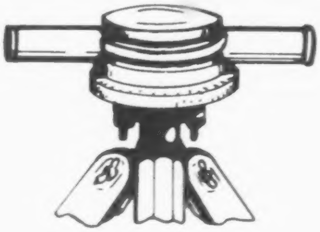
A. Builder's level

FIGURE 2



B. Turret level

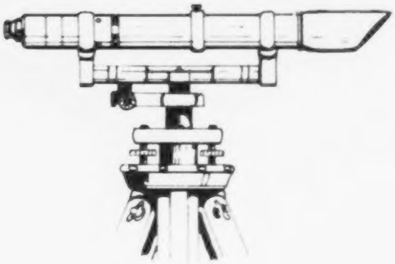
FIGURE 3



INFORMATION SHEET

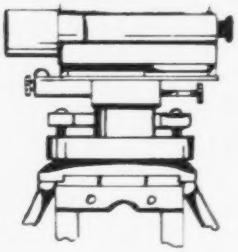
C. Engineer's dumpy level

FIGURE 4



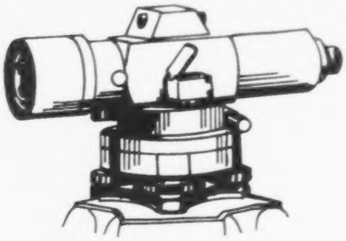
D. Engineer's wild-tilting level

FIGURE 5



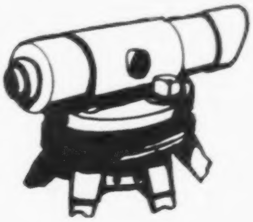
E. Automatic level

FIGURE 6



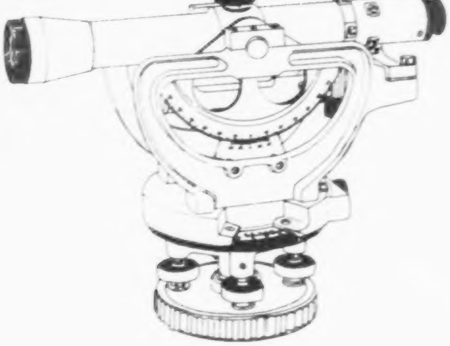
F. Engineer's Zeiss level

FIGURE 7



G. Combination level-transit

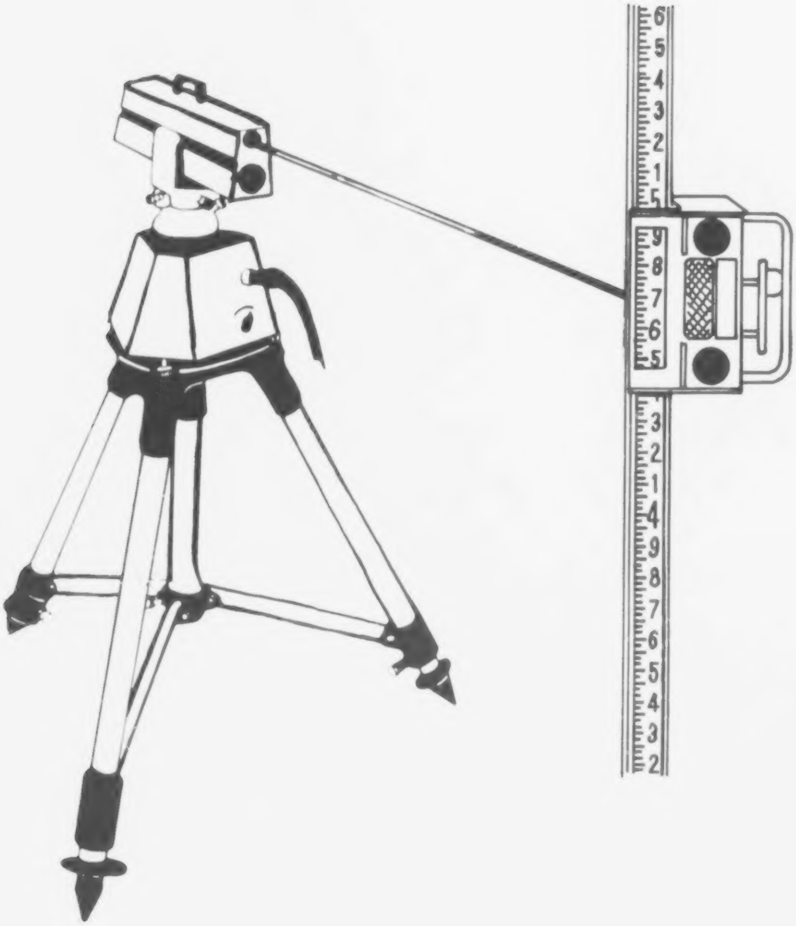
FIGURE 8



INFORMATION SHEET

H. Laser-beam instrument

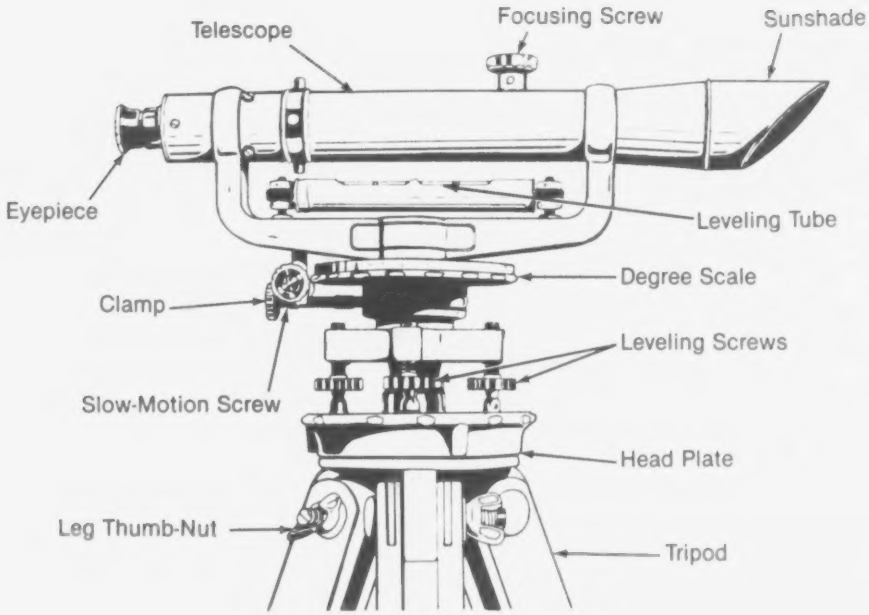
FIGURE 9


6 5 4 3 2 1 5
9 8 7 6 5
3 2 1 4 9 8 7 6 5 4 3 2

INFORMATION SHEET

IV. Parts of a builder's level (Figure 10)

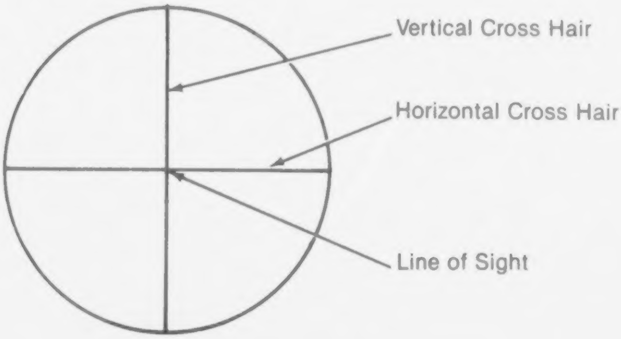
FIGURE 10


Telescope
Focusing Screw
Sunshade
Eyepiece
Leveling Tube
Degree Scale
Clamp
Leveling Screws
Slow-Motion Screw
Head Plate
Leg Thumb-Nut
Tripod

V. Vertical and horizontal cross hairs and line of sight on a leveling instrument (Figure 11)

(NOTE: Vertical cross hairs indicate direction. Horizontal cross hairs indicate the flat plane. The point where the vertical and horizontal cross hairs meet indicates the line of sight.)

FIGURE 11: View as seen through the instrument


Vertical Cross Hair
Horizontal Cross Hair
Line of Sight

INFORMATION SHEET

VI. Rules for proper care of leveling instruments

(NOTE: Leveling instruments are sensitive instruments that require extremely careful treatment.)

A. Keep instrument in carrying case when not in use

B. Protect instrument from shock and vibration when transporting

C. Remove instrument from carrying case by lifting the level bar

(NOTE: *Never* grasp the telescope barrel while removing the instrument from the carrying case.)

D. *Never* force screws or other moving parts of the instrument

E. Place lens and tripod caps in carrying case after removing them from instrument

F. *Do not* remove lenses

G. Clean lenses with soft tissue only

H. Always use sunshade regardless of weather

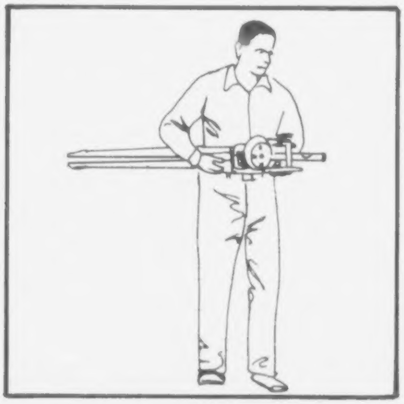
I. Loosen leveling screws before returning instrument to carrying case

J. Carry tripod under your arm with the instrument in front of you (Figure 12)

(NOTE: *Never* carry the tripod over your shoulder when the instrument is attached.)

EXAMPLE:

FIGURE 12



K. Protect instrument from rain, snow, dust, etc.

INFORMATION SHEET

VII. Parts of a leveling rod (Figures 13 and 14)

FIGURE 13: Front view

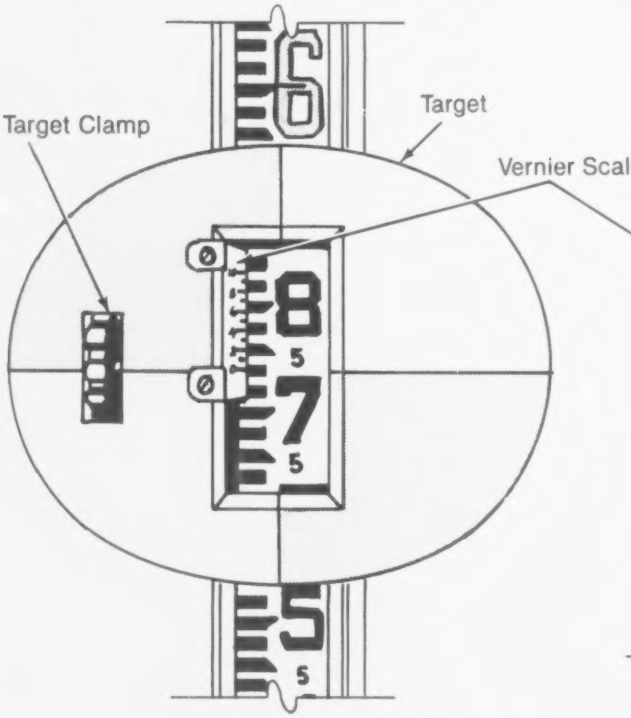
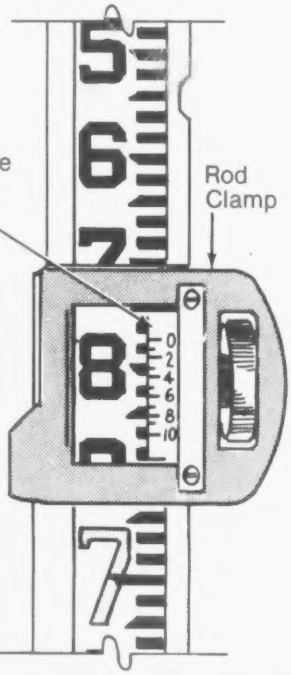


FIGURE 14: Back view



VIII. Uses of parts of a leveling rod

A. Target — Helps make measurements within a certain range on leveling rod; holds vernier scale

(NOTE: The target is usually a red and white disk that slides up and down on the rod.)

B. Target clamp — Holds target in place

C. Rod clamp — Holds rod when extended

D. Vernier scale — Enables reading to the nearest thousandth of a foot or nearest sixty-fourth of a foot

INFORMATION SHEET

IX. Descriptions of commonly used direct-reading rods

(NOTE: There are many types of leveling rods, but the two types of direct-reading rods described below are the ones most commonly used.)

A. Rod graduated in eighths of an inch — Marks indicate feet, inches, and eighths of an inch; each line and each space is one-eighth of an inch thick (See Figure 15)

B. Rod graduated in hundredths of a foot — Marks indicate feet, tenths of a foot, and hundredths of a foot; each line and each space is one hundredths of a foot thick (Figure 16)

EXAMPLES:

FIGURE 15: Rod graduated in eighths of an inch

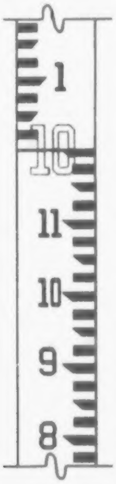
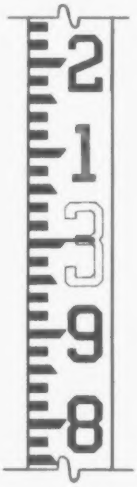


FIGURE 16: Rod graduated in hundredths of a foot



X. Guidelines for reading direct-reading rods (See Figures 17 and 18)

A. Marks at large red numbers indicate full feet

(NOTE: Some rods also have small running-foot numbers spaced at intervals between the large red full-foot numbers.)

B. Marks at small black numbers indicate full inches or tenths of a foot (0.1 foot), depending on rod used

C. Black marks and spaces between full-inch or full-tenth-of-a-foot marks indicate eighths of an inch or hundredths of a foot (0.01 foot), depending on rod used

INFORMATION SHEET

EXAMPLES:

FIGURE 17: Reading a rod graduated in eighths of an inch

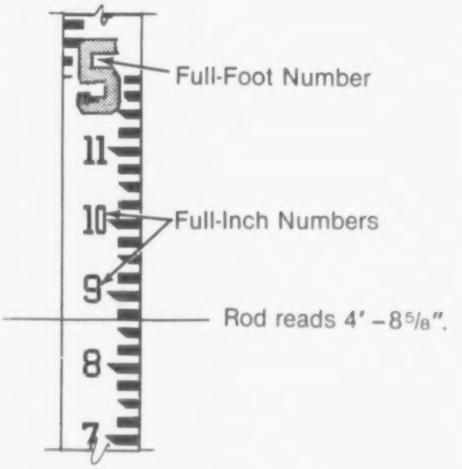
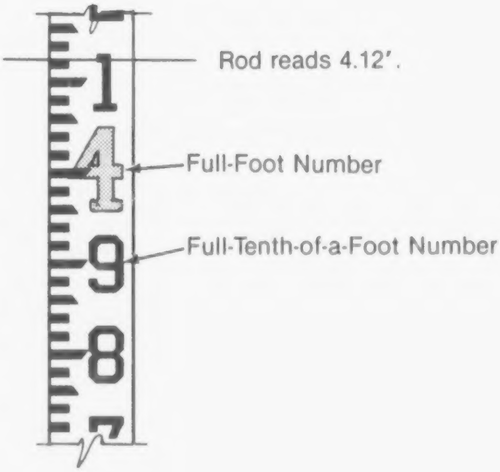

5
Full-Foot Number
11
10
Full-Inch Numbers
9
Rod reads 4'-8⅝".
8
7

FIGURE 18: Reading a rod graduated in hundredths of a foot


Rod reads 4.12'.
1
4
Full-Foot Number
9
Full-Tenth-of-a-Foot Number
8
7

XI. Steps in calculating differences in elevations when performing differential leveling

A. Subtract lower elevation from higher elevation to find difference in elevation

B. Record the difference in elevation and indicate whether elevation is higher or lower than BM

EXAMPLES:

1. Direct-reading rod in eighths of an inch
   BM = 4'-6"
   Elev. = 5'-3"
   5'-3" - 4'-6" = 9"
   Elevation is 9" lower than BM
   BM = 5'-2½"
   Elev. = 3'-7½"
   5'-2½" - 3'-7½" = 1'-7"
   Elevation is 1'-7" higher than BM

2. Direct-reading rod in hundredths of a foot
   BM = 4.43'
   Elev. = 4.12'
   4.43' - 4.12' = .31'
   Elevation is .31' higher than BM
   BM = 3.05'
   Elev. = 6.22'
   6.22' - 3.05' = 3.17'
   Elevation is 3.17' lower than BM

INFORMATION SHEET

XII. Hand signals used by the instrument person to guide the rod person (Figures 19-28)

A. Move in this direction

FIGURE 19

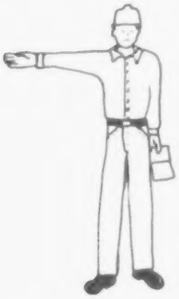
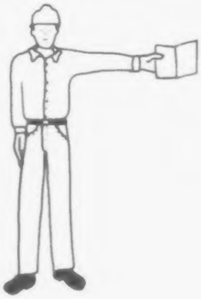
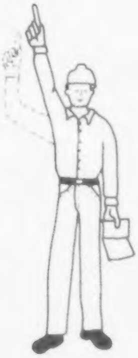


FIGURE 20



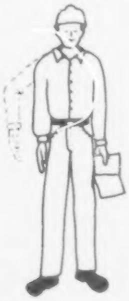
B. Move up

FIGURE 21



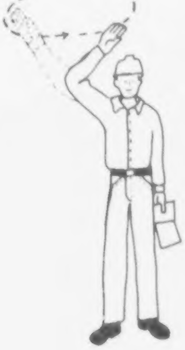
C. Move down

FIGURE 22



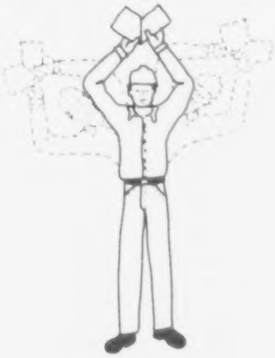
D. Turning point

FIGURE 23



E. Wave rod from side to side

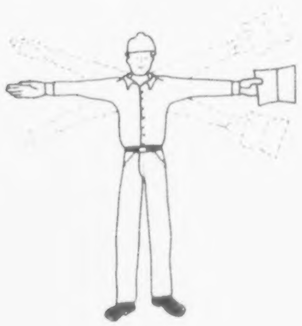
FIGURE 24



INFORMATION SHEET

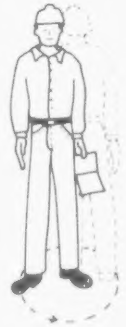
F. Observation completed; move on; understand

FIGURE 25



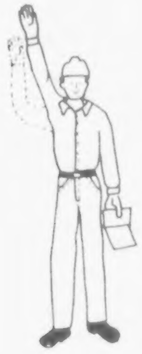
G. Wrong face; check clamp; rod upside down

FIGURE 26



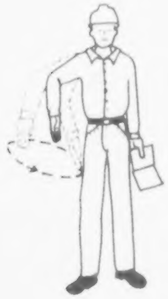
H. Use long rod

FIGURE 27



I. Come in

FIGURE 28



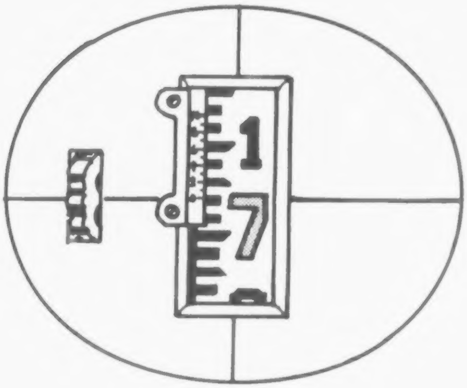
LEVELING INSTRUMENTS
UNIT V

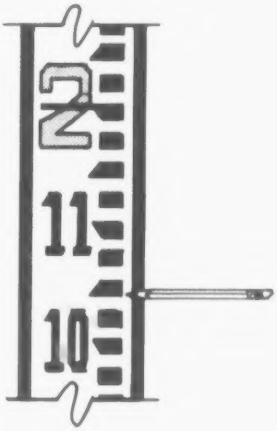
ASSIGNMENT SHEET #1 — READ LEVELING RODS

NAME ______________________________ SCORE ______________

The leveling rod is a very important tool that is used with a leveling instrument to read elevations. With practice, the concrete mason can become skilled at reading elevations and lines quickly and accurately.

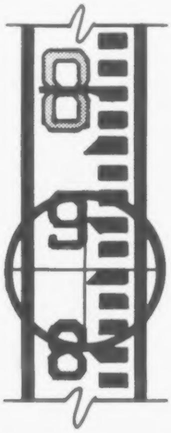
Read each of the following illustrations to the nearest eighth of an inch or hundredth of a foot, depending on the type of rod illustrated. Write the correct answers in the blanks.

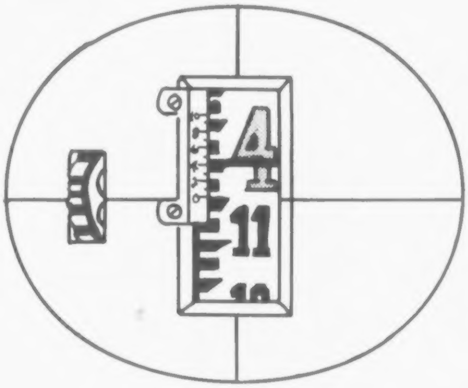




A. ______________________________

B. ______________________________





C. ______________________________

D. ______________________________

LEVELING INSTRUMENTS
UNIT V

ASSIGNMENT SHEET #2 — CALCULATE DIFFERENCES IN ELEVATIONS

NAME ______________________________ SCORE ____________

When using an instrument on slopes and uneven terrain, you will often have to set up the instrument at two or more locations. Learning to calculate differences in elevations will help you set grades and elevations at different levels, and the procedures and calculations used will also help you to determine the height of objects.

Read each of the elevations and bench marks on the field book pages below and on the following pages, and then write in the blanks the differences in elevations, noting whether they are lower or higher than the bench marks. Show your work in the spaces provided at the bottom of each page.

A. Direct-reading rod in eighths of an inch

1.

Rod Readings					
BM		4′ −6 1/2″			
Point 1		4′ −7 1/8″			
Point 2		6′ −0 3/4″			
Point 3		2′ −8 1/2″			
Point 4		5′ −9 5/8″			
Point	Ft. in in.		Higher/lower in elev.		
1 is					than BM
2 is					than BM
3 is					than BM
4 is					than BM

ASSIGNMENT SHEET #2

2.

Rod Readings					
BM		3′ −4¼″			
Point 1		3′ −9″			
Point 2		5′ −2⅛″			
Point 3		1′ −10″			
Point 4		4′ −7⅜″			
Point	Ft. in in.		Higher/lower in elev.		
1 is					than BM
2 is					than BM
3 is					than BM
4 is					than BM
2 is					than 4
1 is					than 4
1 is					than 3

ASSIGNMENT SHEET #2

B. Direct-reading rod in hundredths of a foot

1.

Rod Readings					
BM		4.63′			
Point 1		5.83′			
Point 2		4.50′			
Point 3		6.04′			
Point 4		7.00′			
Point 5		3.87′			
Point	No. of ft.		Higher/lower in elev.		
1 is					than BM
2 is					than BM
3 is					than BM
4 is					than BM
5 is					than BM

ASSIGNMENT SHEET #2

2.

Rod Readings					
BM		3.92′			
Point 1		2.41′			
Point 2		4.76′			
Point 3		3.42′			
Point 4		6.21′			
Point 5		5.65′			
Point	No. of ft.		Higher/lower in elev.		
1 is					than BM
2 is					than BM
3 is					than BM
4 is					than BM
5 is					than BM
2 is					than 4
3 is					than 5
1 is					than 3

LEVELING INSTRUMENTS
UNIT V

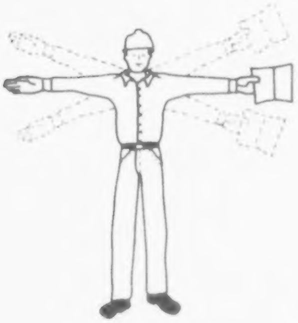
ASSIGNMENT SHEET #3 — DISTINGUISH AMONG HAND SIGNALS USED BY THE INSTRUMENT PERSON TO GUIDE THE ROD PERSON

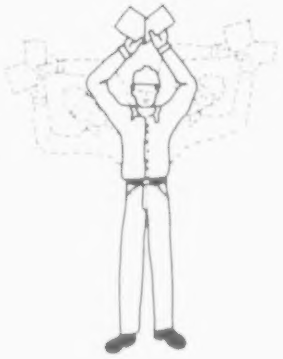
NAME ______________________________ SCORE ______________

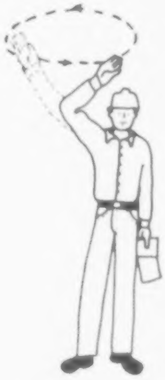
Knowing hand signals will save you many steps and much time when you are operating a leveling instrument.

Distinguish among the following hand signals by writing an "X" in the blank under each correct illustration.

A. Wave rod from side to side

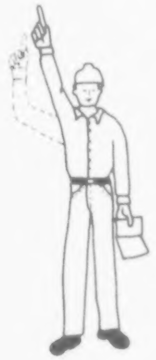


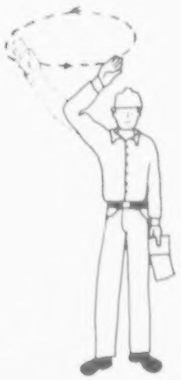


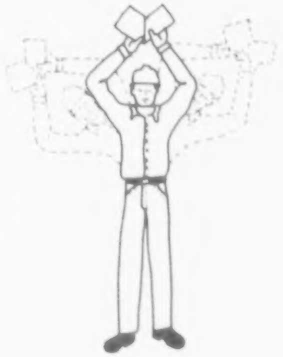


1. ______________ 2. ______________ 3. ______________

B. Move up



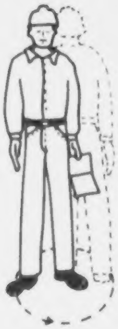


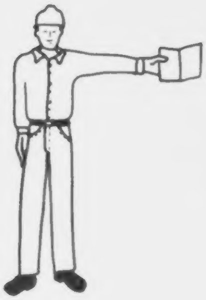


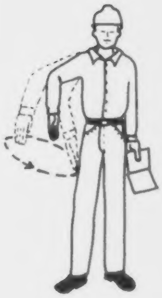
1. ______________ 2. ______________ 3. ______________

ASSIGNMENT SHEET #3

C. Come in

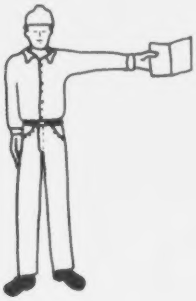


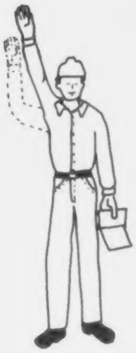


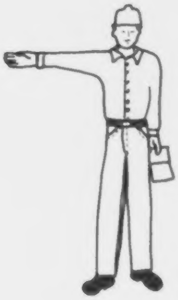


1. ____________________ 2. ____________________ 3. ____________________

D. Move in this direction

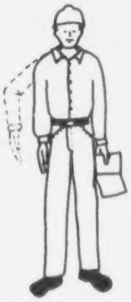


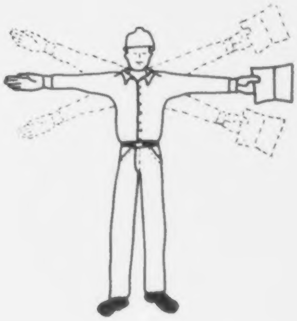


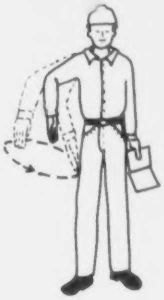


1. ____________________ 2. ____________________ 3. ____________________

E. Observation completed



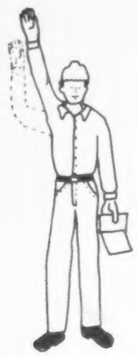


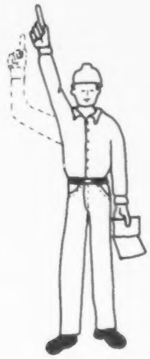


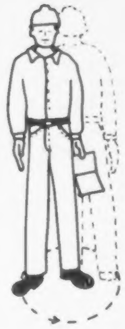
1. ____________________ 2. ____________________ 3. ____________________

ASSIGNMENT SHEET #3

F. Rod upside down

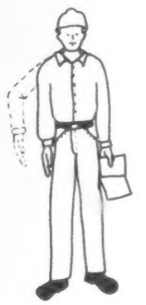


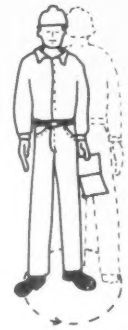


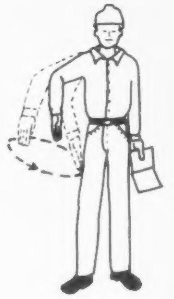


1. ____________ 2. ____________ 3. ____________

G. Move down

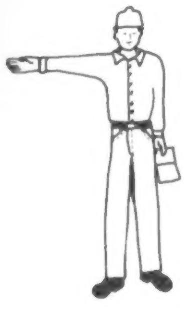


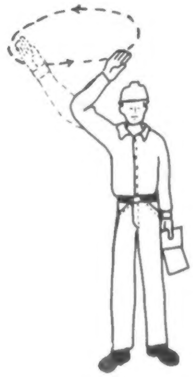


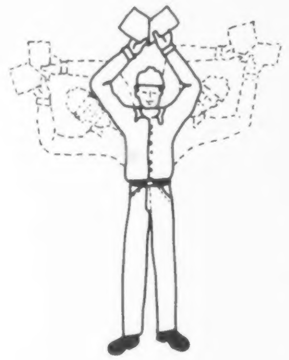


1. ____________ 2. ____________ 3. ____________

H. Turning point



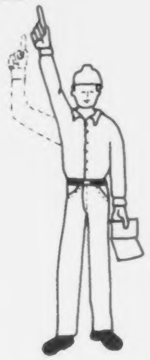


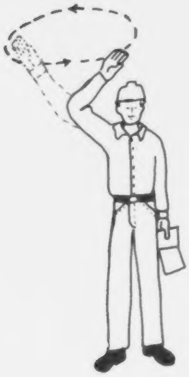


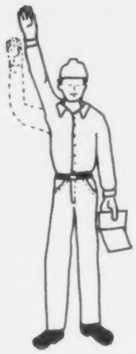
1. ____________ 2. ____________ 3. ____________

ASSIGNMENT SHEET #3

I. Use long rod

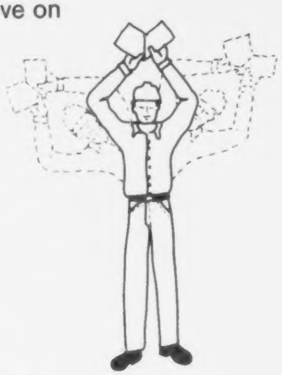


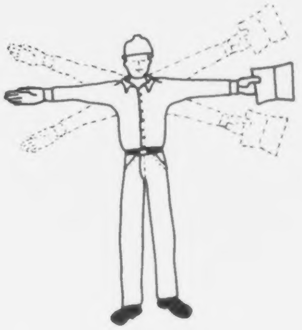


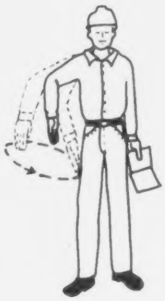


1. ______________ 2. ______________ 3. ______________

J. Move on

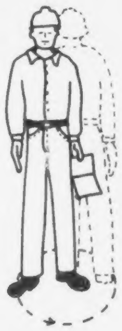


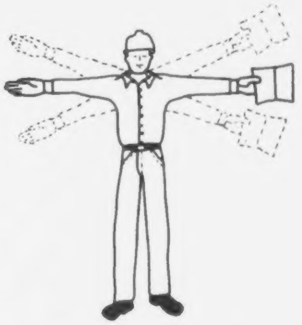


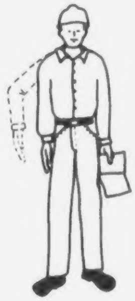


1. ______________ 2. ______________ 3. ______________

K. Wrong face







1. ______________ 2. ______________ 3. ______________

LEVELING INSTRUMENTS
UNIT V

ANSWERS TO ASSIGNMENT SHEETS

Assignment Sheet #1

A. $7.04'$
B. $1'-10\frac{3}{8}''$
C. $7.86'$
D. $3'-11\frac{1}{2}''$

Assignment Sheet #2

A. 1. 1 is $0'-0\frac{5}{8}''$ lower than BM
2 is $1'-6\frac{1}{4}''$ lower than BM
3 is $1'-10''$ higher than BM
4 is $1'-3\frac{1}{8}''$ lower than BM

2. 1 is $0'-4\frac{3}{4}''$ lower than BM
2 is $1'-10\frac{1}{2}''$ lower than BM
3 is $1'-6\frac{1}{4}''$ higher than BM
4 is $1'-3\frac{1}{8}''$ lower than BM
2 is $0'-6\frac{3}{4}''$ lower than 4
1 is $0'-10\frac{3}{8}''$ higher than 4
1 is $1'-11''$ lower than 3

B. 1. 1 is 1.20′ lower than BM
2 is 0.13′ higher than BM
3 is 1.41′ lower than BM
4 is 2.37′ lower than BM
5 is 0.76′ higher than BM

2. 1 is 1.51′ higher than BM
2 is 0.84′ lower than BM
3 is 0.50′ higher than BM
4 is 2.29′ lower than BM
5 is 1.73′ lower than BM
2 is 1.45′ lower than 4
3 is 2.23′ lower than 5
1 is 1.01′ higher than 3

Assignment Sheet #3

A. 2
B. 1
C. 3
D. 1, 3
E. 2
F. 3
G. 1
H. 2
I. 3
J. 2
K. 1

LEVELING INSTRUMENTS
UNIT V

JOB SHEET #1 — SET UP AND ADJUST A TRIPOD AND BUILDER'S LEVEL

I. Equipment

A. Builder's level in carrying case

B. Tripod

II. Procedure

A. Set leg shoes of the two nearest tripod legs in ground about 3 feet apart (See Figure 29)

B. Swing third leg out to form a triangle, placing legs on ground so that head plate is nearly level (Figure 29)

(NOTE: If the ground is not level, you may have to change the position of the tripod in order to keep the head plate level. Always place two tripod legs on the downhill or uneven side.)

FIGURE 29

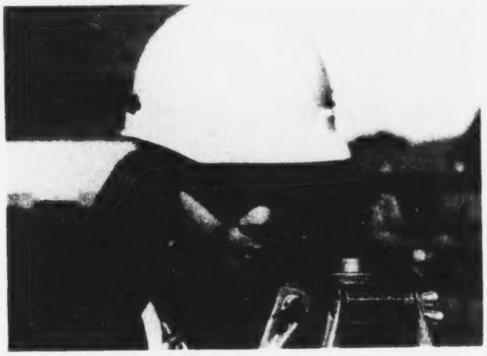
C. Tighten leg thumb-nuts

D. Remove head-plate cap and place cap in carrying case

JOB SHEET #1

E. Check head plate to assure that it is level (Figure 30)

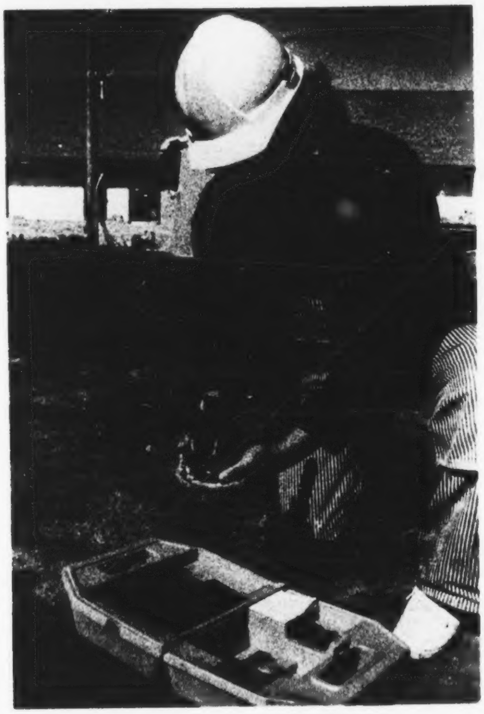
FIGURE 30



F. Remove instrument from carrying case by lifting level bar (Figure 31)

(NOTE: *Never* grasp the telescope barrel while removing instrument from carrying case.)

FIGURE 31

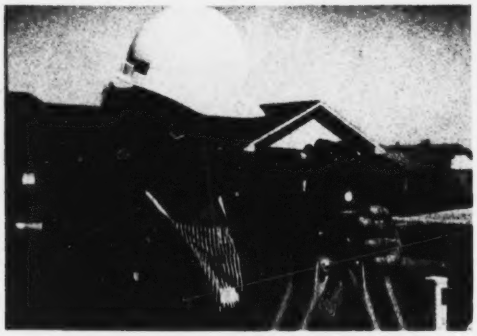


JOB SHEET #1

G. Attach instrument to tripod (Figure 32)

(NOTE: Keep a firm grip on the instrument until it is securely in position on the tripod.)

FIGURE 32



H. Remove dust cap from lens and place cap in carrying case

(NOTE: Between uses, keep the dust cap in place to protect the lens from dust or scratches.)

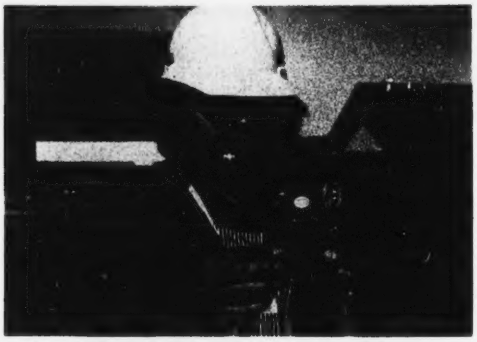
I. Attach sunshade to instrument if sunshade is not a permanent attachment

J. Align telescope barrel directly over one pair of leveling screws

(NOTE: The leveling screws will be used as the name indicates: to level the instrument.)

K. Rotate screws under leveling head by moving your thumbs in opposite directions until bubble is centered in leveling tube (Figure 33)

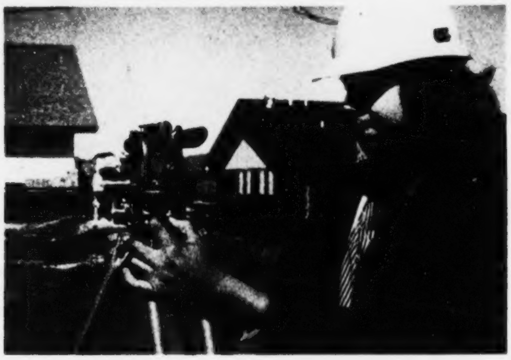
FIGURE 33



L. Turn instrument clockwise 90 degrees to align barrel over other pair of leveling screws

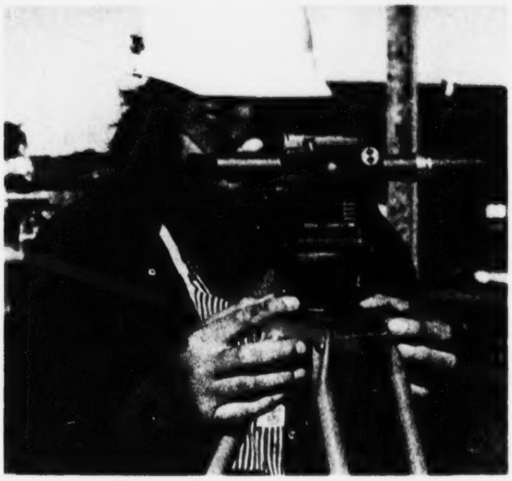
M. Rotate screws under leveling head by moving your thumbs in opposite directions until bubble is centered in leveling tube (Figure 34)

FIGURE 34



N. Turn instrument clockwise 90 degrees to bring it parallel with first pair of leveling screws; center bubble again (Figure 35)

FIGURE 35



O. Turn instrument clockwise 90 degrees to bring it parallel with second pair of leveling screws; center bubble again

(NOTE: Rotate instrument 360 degrees and the bubble should stay in the center regardless of the direction the telescope is pointing. If the bubble does not stay in the center, the instrument is out of level and should be adjusted by competent personnel.)

JOB SHEET #1

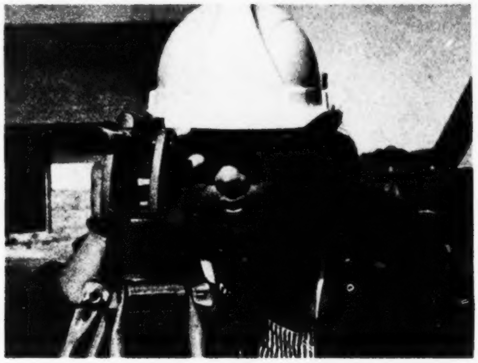
P. Avoid touching tripod after instrument is level

(NOTE: If the instrument creeps off level or is bumped during use, stop and reset the tripod, relevel the instrument, and start again by reestablishing HI from the last known good bench mark.)

Q. Turn eyepiece focusing ring until cross hairs appear clear and sharp (Figure 36)

(NOTE: The target may not be in focus.)

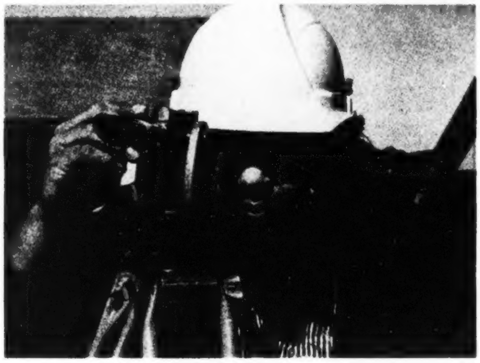
FIGURE 36



R. Rotate focusing screw to bring target into sharp focus (Figure 37)

(NOTE: When the cross hairs and the target are in sharp focus, you should be able to read a rod accurately. Always tie level shots back to the starting bench mark to check for error in rod shots or in field notes.)

FIGURE 37



S. Replace lens dust-cap, disassemble instrument from tripod, and store instrument in carrying case; replace head-plate cap on tripod

T. Store carrying case and tripod

LEVELING INSTRUMENTS
UNIT V

JOB SHEET #2 — USE A BUILDER'S LEVEL TO CHECK FOOTING ELEVATIONS

I. Tools and equipment

A. Builder's level in carrying case

B. Tripod

C. Leveling rod

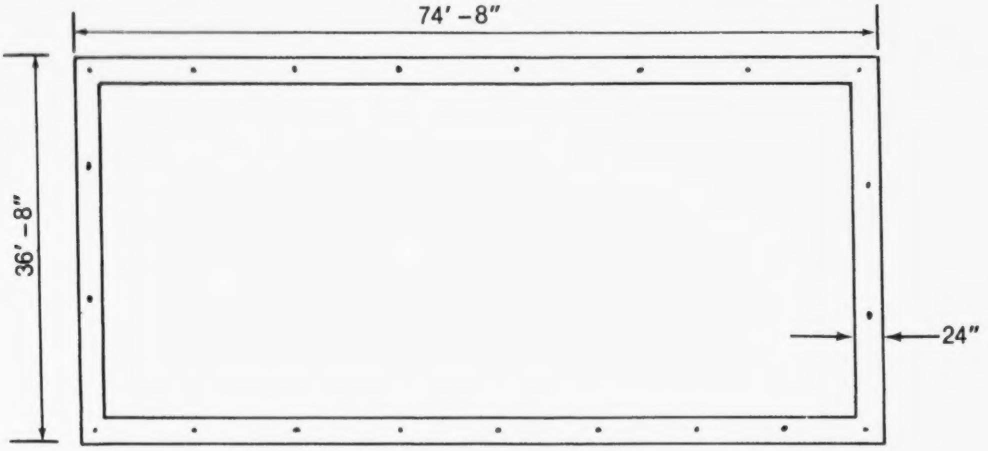
D. Keel

E. Specifications furnished by instructor

F. Drawing (Figure 38)

(NOTE: The footing elevations in this job sheet are 5′ – 1½″. The dots on the drawing indicate checkpoints, which are located at each corner and roughly every 10 to 12 feet completely around the footing. The instructor may prefer to assign other practice elevations and to have the job performed on a shop floor or on a parking lot rather than on actual footings.)

FIGURE 38



JOB SHEET #2

II. Procedure

A. Check drawing (See Figure 38) to see which elevations are to be determined, and establish setup for builder's level

(NOTE: Be certain that the locations of all the elevations can be seen through the builder's level.)

B. Set up and adjust builder's level

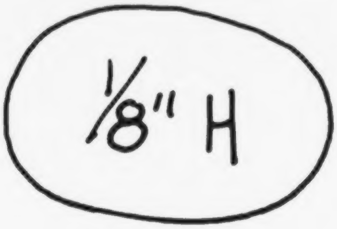
(NOTE: See Job Sheet #1.)

C. While assistant holds leveling rod at first checkpoint, sight through the builder's level and take a reading on leveling rod

D. Have assistant use keel to record on foundation any difference between reading and correct footing elevation, marking *H* for high or *L* for low

(NOTE: Footing elevation is 5′ – 1 1/2″. Reading is 5′ – 1 3/8″. Footing elevation is 1/8 inch higher than correct elevation. Record *1/8″ H* on top of footing. See Figure 39.)

FIGURE 39



E. Have assistant move leveling rod to next checkpoint

F. Adjust builder's level to focus on next checkpoint

G. Sight through the builder's level to the leveling rod and take a reading

H. Have assistant record on footing any difference between reading and correct footing elevation, marking *H* for high or *L* for low

I. Repeat Steps E through H for each checkpoint around footing

J. Check with instructor to see whether footing elevations are all within the ± specifications

K. Disassemble builder's level from tripod and store in carrying case; put away other tools and equipment

LEVELING INSTRUMENTS
UNIT V

JOB SHEET #3 — USE A BUILDER'S LEVEL TO PERFORM DIFFERENTIAL LEVELING

I. Tools and equipment

A. Builder's level

B. Tripod

C. Leveling rod

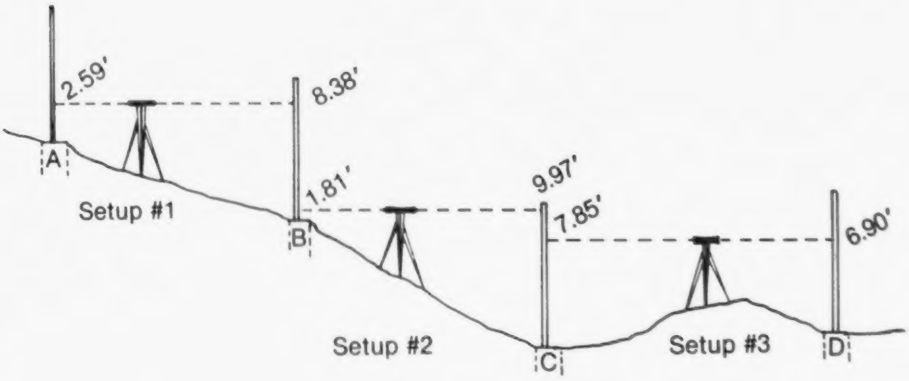
D. Field book

E. Pencil

F. Drawing (Figure 40)

(NOTE: The procedure described in this job sheet is based on the elevations shown in the drawing below. The instructor may prefer to assign other practice elevations. For accuracy, be sure that the leveling instrument is set equidistance between points.)

FIGURE 40



II. Procedure

A. Determine difference in elevation between Points A and B

JOB SHEET #3

1. Check drawing (See Figure 40) to see which elevations are to be determined, and establish Setup #1 for builder's level

   (NOTE: *Do not* set up more than 150 to 200 feet from each point, but be certain that Points A and B can both be seen through the builder's level.)

2. Set up and adjust builder's level at Setup #1

   (NOTE: See Job Sheet #1.)

3. While assistant holds leveling rod at Point A, sight through the builder's level and take a reading on leveling rod

4. Record reading in field book

   (NOTE: The line of sight at Point A is 2.59 feet from Setup #1.)

5. Have assistant move leveling rod to Point B

6. Adjust builder's level to focus on Point B

7. Sight through builder's level and take a reading on leveling rod

8. Record reading in field book

   (NOTE: The line of sight at Point B is 8.38 feet from Setup #1.)

9. Record plus and minus readings in field book (Figure 41)

   (NOTE: Plus sight is the rod reading from the point to the line of sight. Minus sight is the rod reading from the line of sight to the point.)

FIGURE 41

Setup	+ Rod	H I	− Rod	Elevation
1	2.59			
			8.38	

JOB SHEET #3

B. Determine difference in elevation between Points B and C

1. Check drawing (See Figure 40) to see which elevations are to be determined, and establish Setup #2 for builder's level

   (NOTE: *Do not* set up more than 150 to 200 feet from each point, but be certain that Points B and C can both be seen through the builder's level.)

2. Set up and adjust builder's level at Setup #2

   (NOTE: See Job Sheet #1.)

3. While assistant holds leveling rod at Point B, sight through the builder's level and take a reading on leveling rod

4. Record reading in field book

   (NOTE: The line of sight at Point B is 1.81 feet from Setup #2.)

5. Have assistant move leveling rod to Point C

6. Adjust builder's level to focus on Point C

7. Sight through builder's level and take a reading on leveling rod

8. Record reading in field book

   (NOTE: The line of sight at Point C is 9.97 feet from Setup #2.)

9. Record plus and minus readings in field book (Figure 42)

FIGURE 42

Setup	+ Rod	H I	− Rod	Elevation
1	2.59			
			8.38	
2	1.81			
			9.97	

C. Determine difference in elevation between Points C and D

1. Check drawing (See Figure 40) to see which elevations are to be determined, and establish Setup #3 for builder's level

   (NOTE: *Do not* set up more than 150 to 200 feet from each point, but be certain that Points C and D can both be seen through the builder's level.)

JOB SHEET #3

2. Set up and adjust builder's level at Setup #3

   (NOTE: See Job Sheet #1.)

3. While assistant holds leveling rod at Point C, sight through builder's level and take a reading on leveling rod

4. Record reading in field book

   (NOTE: The line of sight at Point C is 7.85 feet from Setup #3.)

5. Have assistant move leveling rod to Point D

6. Adjust builder's level to focus on Point D

7. Sight through builder's level and take a reading on leveling rod

8. Record reading in field book

   (NOTE: The line of sight at Point D is 6.90 feet from Setup #3.)

9. Record plus and minus reading in field book (Figure 43)

FIGURE 43

Setup	+ Rod	H I	− Rod	Elevation
1	2.59			
			8.38	
2	1.81			
			9.97	
3	7.85			
			6.90	

D. Total plus sight column and minus sight column in field book (See Figure 44)

JOB SHEET #3

FIGURE 44

Setup	$\overset{+}{\text{Rod}}$	H I	$\overset{-}{\text{Rod}}$	Elevation
1	2.59			
			8.38	
2	1.81			
			9.97	
3	7.85			
			6.90	
Sum	12.25		25.25	

E. Subtract smaller number from larger to find the difference in elevations

(NOTE: Subtracting 12.25 feet from 25.25 feet, leaves 13.00 feet. Point D is 13.00 feet lower than Point A.)

F. Disassemble builder's level from tripod, and store instrument in carrying case; put away carrying case, tripod, and other tools and equipment

LEVELING INSTRUMENTS
UNIT V

JOB SHEET #4 — CONNECT PLUMB BOB TO AN INSTRUMENT

I. Equipment

- A. Transit in carrying case
- B. Tripod
- C. Plumb bob with cord

II. Procedure

- A. Set leg shoes of the two nearest tripod legs in ground about 3 feet apart
- B. Swing third leg out to form a triangle, placing legs on ground so that head plate is nearly level

  (NOTE: If the ground is not level, you may have to change the position of the tripod in order to keep the head plate level. Always place two legs on the downhill or uneven side.)

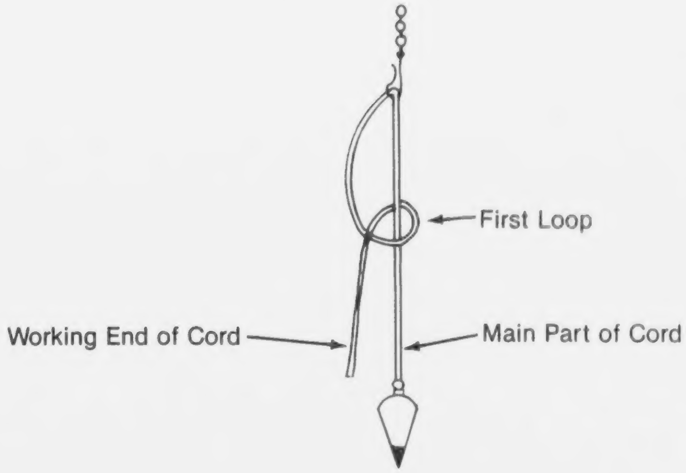
- C. Tighten leg thumb-nuts
- D. Check head plate to assure that it is level
- E. Remove transit from carrying case by lifting its baseplate

  (NOTE: *Never* grasp the telescope barrel while removing the transit from the carrying case.)

- F. Still holding transit by its baseplate, attach transit to tripod
- G. Loop plumb-bob cord over hook on transit
- H. Knot cord
  - 1. Make first loop in cord (See Figure 45)
    - a. Bring working end of cord in front of main part of cord
    - b. Take working end behind main part of cord
    - c. Draw working end through space between working end and main part of cord

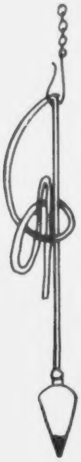
JOB SHEET #4

FIGURE 45


First Loop
Working End of Cord
Main Part of Cord

2. Make a second loop in working end of cord (See Figure 46)
3. Pass second loop up through bottom of first loop (Figure 46)

FIGURE 46

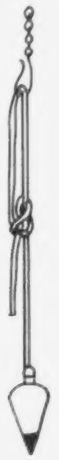


JOB SHEET #4

4. Tighten knot (Figure 47)

   (NOTE: This knot secures the plumb bob without affecting the true perpendicular.)

FIGURE 47



I. Remove plumb bob from tripod, disassemble transit from tripod, and store instrument in carrying case

J. Put away carrying case, tripod, and plumb bob

LEVELING INSTRUMENTS
UNIT V

JOB SHEET #5 — SET UP AND ADJUST A COMBINATION LEVEL-TRANSIT

I. Tools and equipment

A. Combination level-transit in carrying case

B. Tripod

C. Plumb bob with cord

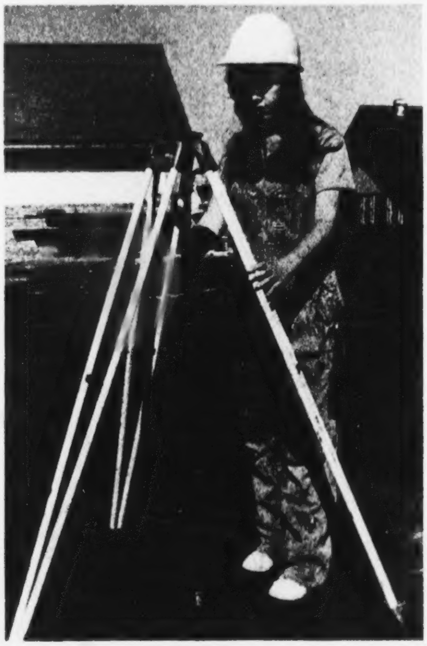
D. Stake driven in ground and marked with established point (provided by instructor)

II. Procedure

A. Over stake at point established by instructor, set leg shoes of the two nearest tripod legs in ground about 3 feet apart; swing third leg out to form a triangle, placing legs on ground so that head plate is nearly level (Figure 48)

(NOTE: If the ground is not level, you may have to change the position of the tripod in order to keep the head plate level. Always place two tripod legs on the downhill or uneven side.)

FIGURE 48

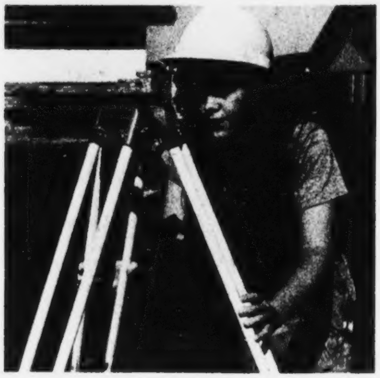


JOB SHEET #5

B. Tighten leg thumb-nuts

C. Check head plate to assure that it is level (Figure 49)

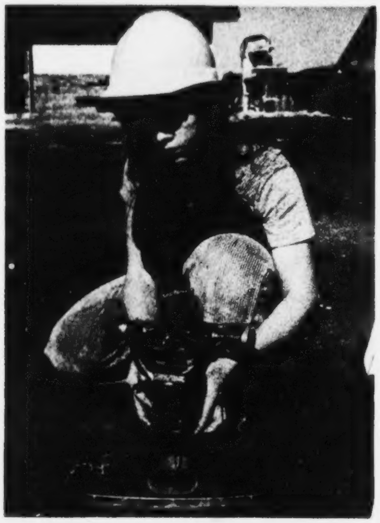
FIGURE 49



D. Remove instrument from carrying case by lifting its baseplate (Figure 50)

(NOTE: *Never* grasp the telescope barrel while removing the instrument from the carrying case.)

FIGURE 50



E. Still holding instrument by its baseplate, attach instrument to tripod

F. Remove dust cap from lens and place cap in carrying case

JOB SHEET #5

G. Attach sunshade to instrument

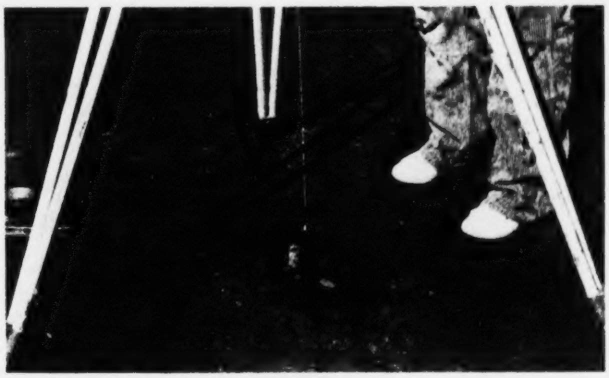
H. Attach plumb bob to instrument

(NOTE: Follow the procedure in Steps G and H in Job Sheet #4.)

I. Center instrument on footplate

J. Bring plumb bob to a position within 2 or 3 inches of established point on stake, moving tripod and instrument together (Figure 51)

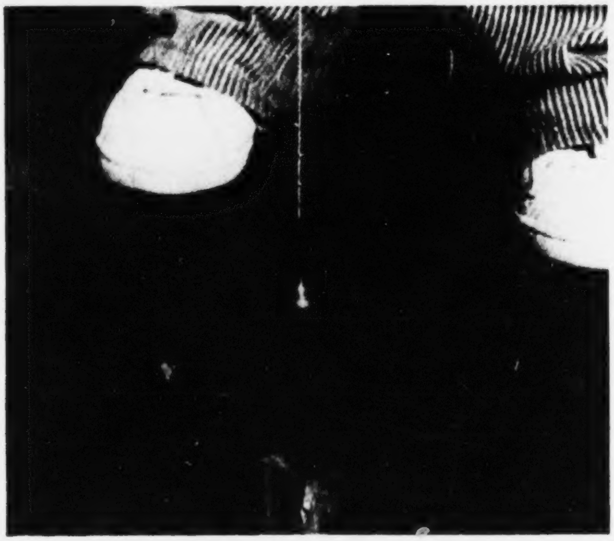
FIGURE 51



K. Firmly set tripod legs into ground

L. Raise or lower plumb bob until it hangs about 1 inch above established point on stake (Figure 52)

FIGURE 52

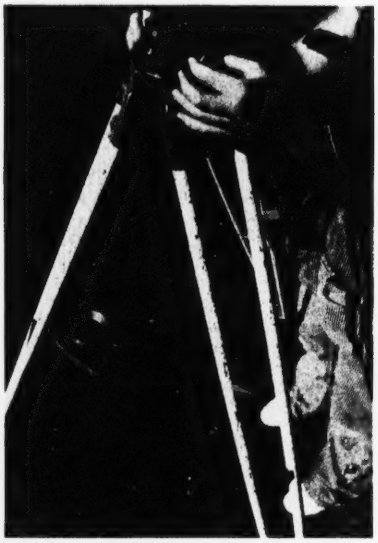


JOB SHEET #5

M. Moving tripod legs from side to side, adjust legs as required to bring plumb bob within ¼ inch of established point on stake

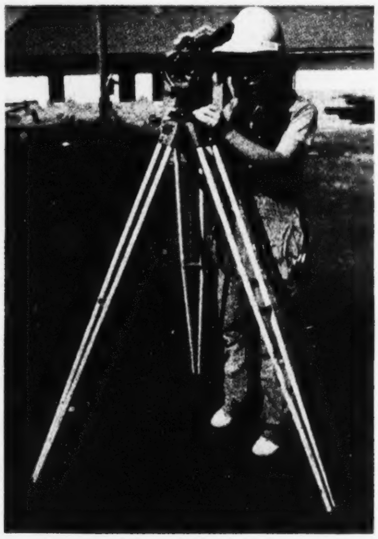
N. Loosen one pair of leveling screws (Figure 53)

FIGURE 53



O. Slide leveling head until plumb bob and the center of the small ellipse in which plumb bob swings are exactly over established point on stake (Figure 54)

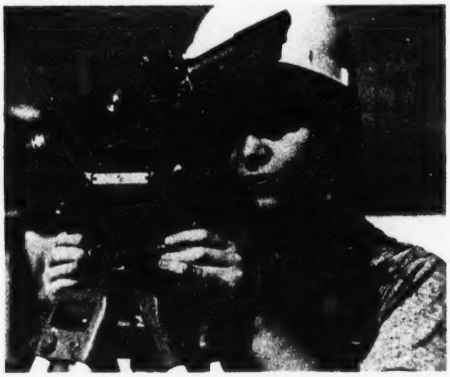
FIGURE 54



JOB SHEET #5

P. Tighten leveling screws firmly (Figure 55)

FIGURE 55



Q. Level instrument

(NOTE: Follow the procedure for the builder's level in Steps J through R of Job Sheet #1.)

R. Replace lens dust-cap, remove plumb bob from instrument, disassemble instrument from tripod, and store instrument in carrying case

S. Store carrying case, tripod, and other tools and equipment

LEVELING INSTRUMENTS
UNIT V

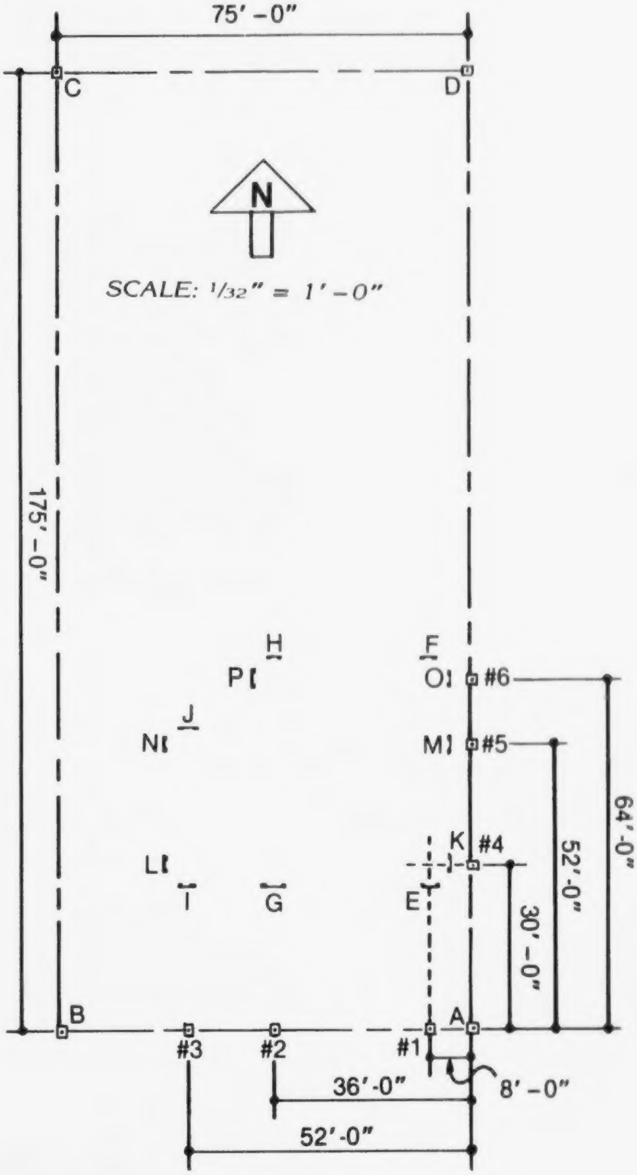
JOB SHEET #6 — USE A COMBINATION LEVEL-TRANSIT TO LOCATE BUILDING-LINE POINTS ON BATTER BOARDS

I. Tools and equipment

- A. Combination level-transit in carrying case
- B. Tripod
- C. Plumb bob with cord
- D. 200-foot tape
- E. Claw hammer
- F. Stakes
- G. Sledgehammer
- H. Surveyor's tacks
- I. Nails
- J. Batter-board layout (Figure 56)

  (NOTE: The angle formed by Lines AB and AD is a 90-degree angle.)

FIGURE 56


75'–0"
C
D
N
SCALE: 1/32" = 1'–0"
175'–0"
H
F
P
O
#6
J
N
M
#5
64'–0"
K
#4
52'–0"
L
I
G
E
30'–0"
B
A
#3
#2
#1
36'-0"
8'–0"
52'-0"

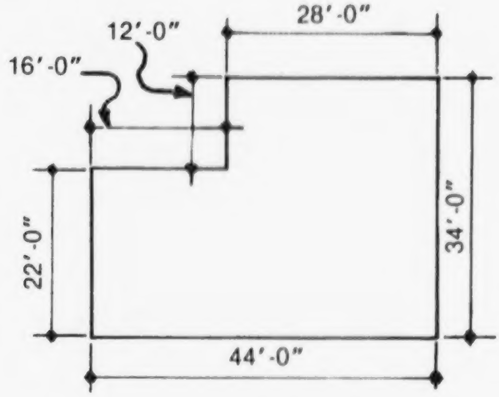
JOB SHEET #6

II. Procedure

A. Study batter-board layout (See Figure 56) and building dimensions (Figure 57)

(NOTE: The instructor has established property-line Points A, B, C, and D and has marked these points on the lot with stakes and surveyor's tacks; the instructor has also determined that the angle formed by Lines AB and AD is a 90-degree angle. The instructor has also set the batter boards for a building on a 75′ −0″ × 175′ −0″ lot. The building is set back 30 feet from the south boundary and 8 feet from the east boundary.)

FIGURE 57



B. Check tacks on property-line stakes to make certain that Line AB is straight

1. Set up and adjust level-transit over Point A

   (NOTE: See Job Sheet #5.)

2. Loosen vertical-motion clamp screws

3. Tilt instrument downward, and sight through telescope at tack on Point B

4. Focus instrument on tack on stake at Point B to determine whether Line AB is straight

   (NOTE: If Line AB is not straight, notify the instructor.)

5. Tighten vertical-motion clamp screws

   (NOTE: *Do not* overtighten screws.)

C. Check tacks on property-line stakes to make certain that Line AD is straight

1. With instrument still focused on Point B, set the 360-degree scale at zero

JOB SHEET #6

   2. Loosen horizontal-motion clamp screws, and turn instrument clockwise until the scale indicates that a 90-degree arc has been completed

      (NOTE: The instrument should now be at Line AD.)

   3. Tighten horizontal-motion clamp screws

      (NOTE: *Do not* overtighten screws.)

   4. Use tangent screw to make final 90-degree adjustments

   5. Loosen vertical-motion clamp screws, and adjust tilt of instrument to sight at Point D

   6. Focus instrument on tack on stake at Point D to determine whether Line AD is straight

      (NOTE: If Line AD is not straight, notify the instructor.)

   7. Tighten vertical-motion clamp screws

D. Establish setup Locations #1, #2, and #3 along Line AB

   1. Beginning at Point A, use tape to measure along Line AB to establish locations at distances of 8 feet, 36 feet, and 52 feet (See Figure 56)

      (NOTE: *Do not* disturb level-transit.)

   2. Drive a stake at each location

   3. Set a tack in top of each stake at exact measured distance from Point A

E. Establish setup Locations #4, #5, and #6 along Line AD

   1. Beginning at Point A, use tape to measure along Line AD to establish locations at distances of 30 feet, 52 feet, and 64 feet (See Figure 56)

      (NOTE: *Do not* disturb level-transit.)

   2. Drive a stake at each location

   3. Set a tack in top of each stake at exact measured distance from Point A

F. Check tacks on setup Stakes #4, #5, and #6 along Line AD to make sure that they are in a straight line

   1. With instrument still sighted on tack on stake at Point D, focus instrument and take a reading to determine whether tacks on Stakes #4, #5, and #6 along Line AD are in a straight line

   2. Have assistant adjust tacks on stakes as necessary

JOB SHEET #6

G. Check tacks on Setup #1, #2, and #3 along Line AB to make sure that they are in a straight line

1. With instrument still focused on Point D, set the 360-degree scale at zero
2. Loosen horizontal-motion clamp screws, and turn instrument clockwise until the scale indicates that a 90-degree arc has been completed

   (NOTE: Level-transit should now be at Line AB.)

3. Tighten horizontal-motion clamp screws

   (NOTE: *Do not* overtighten screws.)

4. Use tangent screw to make final 90-degree adjustments
5. Loosen vertical-motion clamp screws, and adjust tilt of instrument to sight at Point B
6. Focus instrument and take a reading to determine whether tacks on setup Stakes #1, #2, and #3 along Line AB are straight
7. Have assistant adjust tacks as necessary
8. Tighten vertical-motion clamp screws

   (NOTE: *Do not* overtighten screws.)

H. Locate building-line Points E and F on batter boards

1. Set up and adjust level-transit over Stake #1 at 8-foot location on Line AB

   (NOTE: See Job Sheet #5.)

2. Loosen vertical-motion clamp screws
3. While assistant holds a nail on batter board, tilt instrument and sight through telescope to determine correct location for Point E
4. Have assistant adjust location of nail as necessary until correct location is established
5. Have assistant drive nail into batter board at exact location established
6. While assistant holds a nail on batter board, sight through telescope to determine correct location for Point F
7. Have assistant adjust location of nail as necessary until correct location is established

JOB SHEET #6

8. Have assistant drive nail into batter board at exact location established

9. Tighten vertical-motion clamp screws

   (NOTE: *Do not* overtighten screws.)

I. Locate building-line Points G and H on batter boards

1. Set up and adjust level-transit over Stake #2 at 36-foot location on Line AB

   (NOTE: See Job Sheet #5.)

2. Loosen vertical-motion clamp screws

3. While assistant holds a nail on batter board, tilt instrument and sight through telescope to determine correct location for Point G

4. Have assistant adjust location of nail as necessary until correct location is established

5. Have assistant drive nail into batter board at exact location established

6. While assistant holds a nail on batter board, sight through telescope to determine correct location for Point H

7. Have assistant adjust location of nail as necessary until correct location is established

8. Have assistant drive nail into batter board at exact location established

9. Tighten vertical-motion clamp screws

   (NOTE: *Do not* overtighten screws.)

J. Locate building-line Points I and J on batter boards

1. Set up and adjust level-transit over Stake #3 at 52-foot location on Line AB

   (NOTE: See Job Sheet #5.)

2. Loosen vertical-motion clamp screws

3. While assistant holds a nail on batter board, tilt instrument and sight through telescope to determine correct location for Point I

4. Have assistant adjust location of nail as necessary until correct location is established

5. Have assistant drive nail into batter board at exact location established

JOB SHEET #6

6. While assistant holds a nail on batter board, sight through telescope to determine correct location for Point J

7. Have assistant adjust location of nail as necessary until correct location is established

8. Have assistant drive nail into batter board at exact location established

9. Tighten vertical-motion clamp screws

   (NOTE: *Do not* overtighten screws.)

K. Using procedure described above, set up level-transit over Stake #4 at 30-foot location on Line AD, and locate building-line Points K and L on batter boards

L. Using procedure described above, set up level-transit over Stake #5 at 52-foot location on Line AD, and locate building-line Points M and N on batter boards

M. Using procedure described above, set up level-transit over Stake #6 at 64-foot location on Line AD, and locate building-line Points O and P on batter boards

N. Replace lens dust-cap, remove plumb bob from instrument, disassemble instrument from tripod, and store instrument in carrying case; store carrying case and tripod

O. Put away other tools and equipment

LEVELING INSTRUMENTS
UNIT V

TEST

NAME ____ SCORE ________________

1. Select correct definitions of terms associated with leveling instruments. Write an "X" in the blank beside the best definition.

   a. **Bench mark (BM)**

      ______1. Proposed or future level of ground at construction line

      ______2. Given grade

      ______3. Permanent point of known or assumed elevation

   b. **Fall**

      ______1. Angle or degree of slope

      ______2. Slope of a line, usually given in inches per foot

      ______3. Distance from top to bottom of a slope

   c. **Laser-beam instrument**

      ______1. Very precise leveling instrument used to establish straight lines

      ______2. Leveling instrument consisting of a telescope and leveling bubble; used with a tripod and leveling rod primarily for establishing grade levels

      ______3. Automatic leveling instrument that uses a laser beam to establish elevation readings

   d. **Cross hairs**

      ______1. Tool or device attached to a string; used to set and check vertical or perpendicular of a surface

      ______2. Fine horizontal and vertical lines in telescope barrel of leveling instrument; used as a reference line in the field or for marking instrumental axis

      ______3. Additional horizontal lines in telescope eyepiece; used to determine distance between leveling rod and plumb bob

TEST

e. **Grade stake**

_____1. Stake driven into ground at proposed grade

_____2. Stake driven into ground and used as a pivot to swing a radius

_____3. Stake driven into ground for temporary bench mark

f. **Field book**

_____1. Small book used to record instrument readings for layout and elevations of proposed structures

_____2. Reference book used in the field

_____3. Small book used to record employee's time worked

g. **Plumb bob**

_____1. Elevation reference point used when the permanent point is not in sight

_____2. Tool or device attached to a string; used to set and check vertical or perpendicular of a surface

_____3. Device for establishing a horizontal line or plane by means of a bubble that shows adjustment to the horizontal by movement to the center of a glass tube

h. **Builder's level**

_____1. Automatic leveling instrument used to establish elevation readings

_____2. Very precise leveling instrument used to establish straight lines and to measure horizontal and vertical angles

_____3. Instrument consisting of a telescope and leveling bubble; used with a tripod and leveling rod primarily for establishing grade levels

i. **Finish-floor height**

_____1. Elevation of finished floor in relation to bench mark

_____2. Elevation of finished floor in relation to the structure

_____3. Proposed or future level of finished floor

TEST

j. **Surveying**

______1. Art of showing the configuration of a surface, including its relief and the location of its natural and constructed features

______2. Art or science of determining area and configuration of portions of earth's surface with a maximum of accuracy

______3. Leveling method by which the difference in elevation between two points is determined by plus and minus rod readings that are totaled and adjusted to bench mark

k. **Site**

______1. Boundaries around a plot of ground

______2. Plot of ground established by law, fixing face of structure a minimum distance from right of way

______3. Plot of ground on which a project is to be constructed

l. **Height of instrument (HI)**

______1. Vertical distance from bench mark to line of sight of leveling instrument

______2. Vertical distance from ground to top of leveling instrument

______3. Vertical distance from finish-floor grade to line of sight of leveling instrument

m. **Elevation**

______1. Front or side view of a structure

______2. Finish-floor grade

______3. Given grade

n. **Leveling rod**

______1. Rod with markings graduated upward from zero; used with leveling instrument to determine elevations

______2. Rod upon which all elevations are indicated for openings required on job

______3. Set of three rods of exact length used to sight across to establish grade

TEST

o. **Differential leveling**

_____1. Method whereby finish-floor elevation is determined to be different from bench mark

_____2. Method by which the difference in elevation between two points is determined by plus and minus rod readings that are totaled and adjusted to bench mark

_____3. Method whereby the amount of fall in a slope is measured

p. **Temporary bench mark (TBM)**

_____1. Elevation of finished floor in relation to bench mark

_____2. Permanent point of known or assumed elevation

_____3. Elevation reference point used when permanent point is not in sight

q. **Grade line**

_____1. Proposed or future level of ground at construction line

_____2. Given grade

_____3. Proposed grade of the finished floor

r. **Perpendicular**

_____1. Exactly upright; at a right angle (90-degree angle) to another line or surface

_____2. Exactly in line with another line or surface

_____3. Extending in the same direction, everywhere equidistant, and not meeting

2. List two uses of leveling instruments.

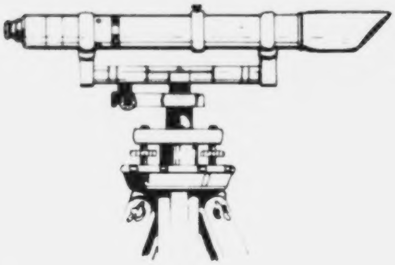
a. ____

b. ____

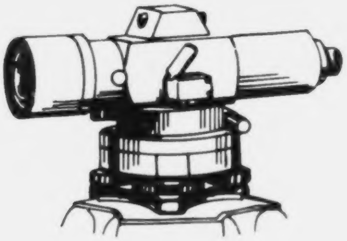
TEST

3. Identify the types of leveling instruments illustrated below and on the following page. Write the correct names in the blanks.

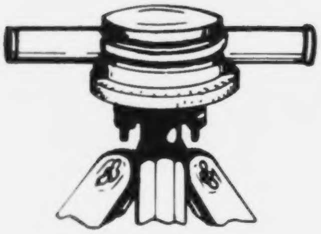
Builder's level
Turret level
Engineer's Zeiss level
Laser-beam instrument
Engineer's wild-tilting level
Combination level-transit
Automatic level
Engineer's dumpy level



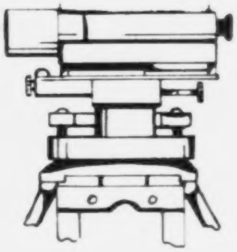
a. ______________________________



b. ______________________________

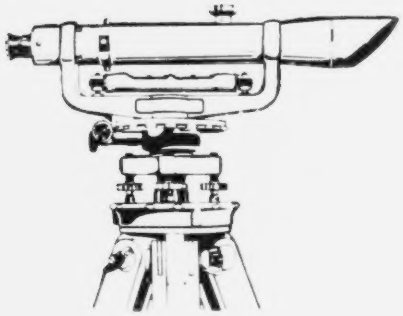


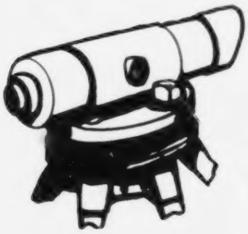
c. ______________________________



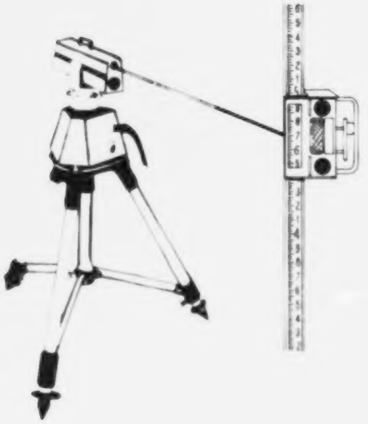
d. ______________________________

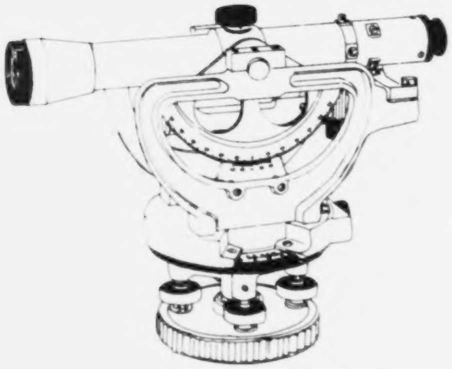
TEST





e. ________________________________ f. ________________________________



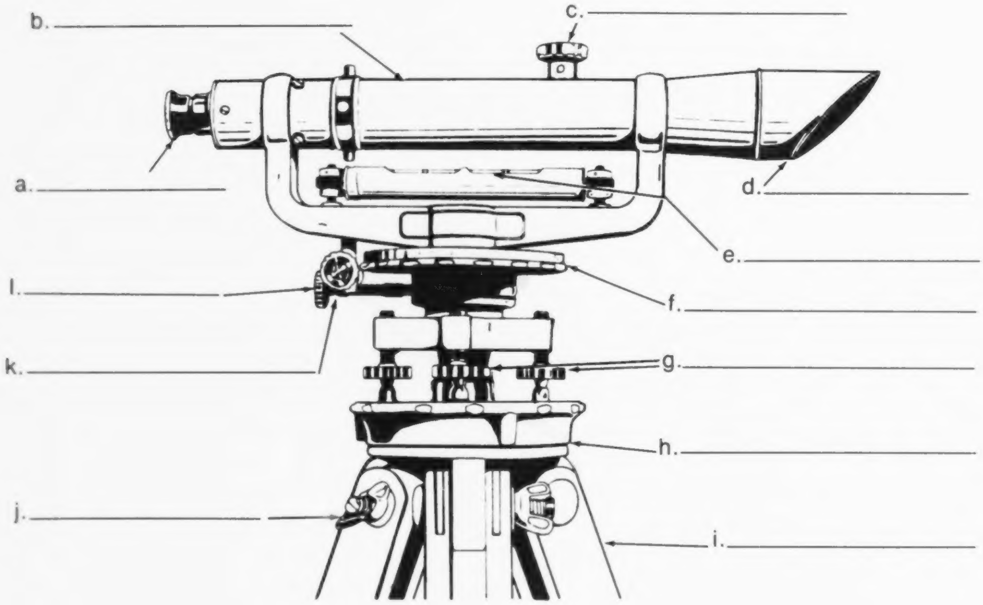


g. ________________________________ h. ________________________________

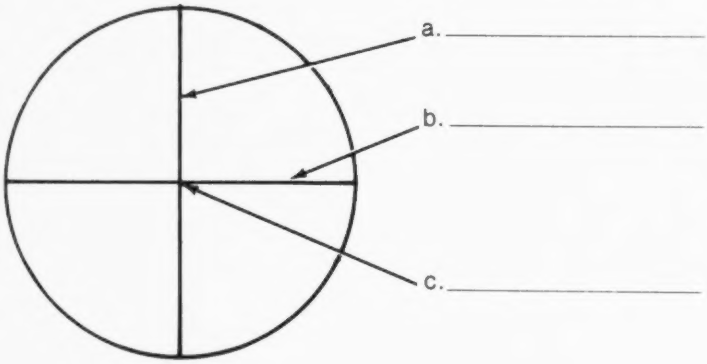
TEST

4. Identify the parts of the builder's level illustrated below. Write the correct names in the blanks.

Telescope
Slow-motion screw
Leveling screws
Leg thumb-nut
Leveling tube
Eyepiece
Sunshade
Degree scale
Focusing screw
Tripod
Clamp
Head plate



5. Label vertical and horizontal cross hairs and line of sight on the leveling instrument illustrated below.



TEST

6. State five rules for proper care of leveling instruments.

   a. ______________________________

   b. ______________________________

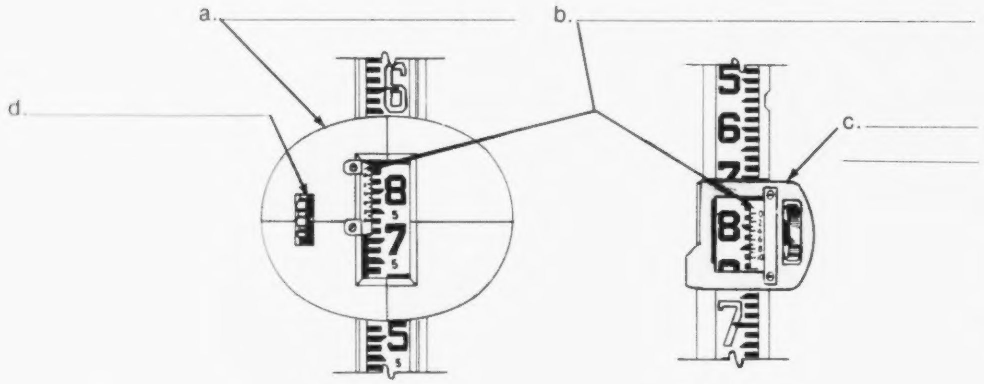
   c. ______________________________

   d. ______________________________

   e. ______________________________

7. Identify the parts of the leveling rod illustrated below. Write the correct names in the blanks.

Rod clamp **Target clamp** **Vernier scale** **Target**



Front View Back View

8. Match parts of a leveling rod to their correct uses. Write the correct numbers in the blanks.

______a. Holds target in place

______b. Holds rod when extended

______c. Helps make measurements within a certain range on leveling rod; holds vernier scale

______d. Enables reading to the nearest thousandth of a foot or nearest sixty-fourth of a foot

1. Target
2. Target clamp
3. Vernier scale
4. Rod clamp

TEST

9. Describe commmonly used direct-reading rods.

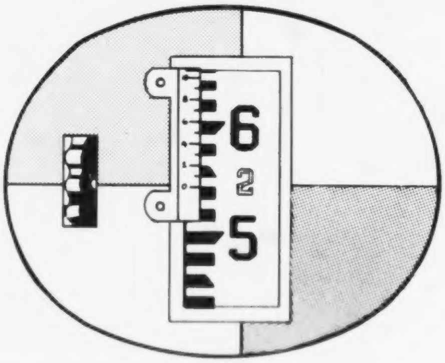
   a. Rod graduated in eighths of an inch — ______________________________

   ____

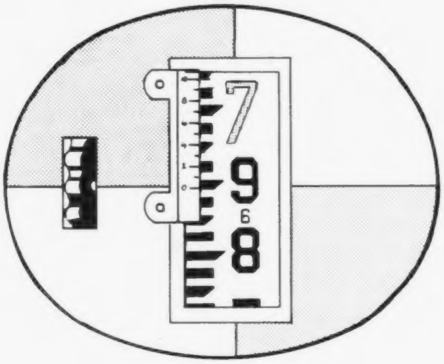
   b. Rod graduated in hundredths of a foot — ______________________________

   ____

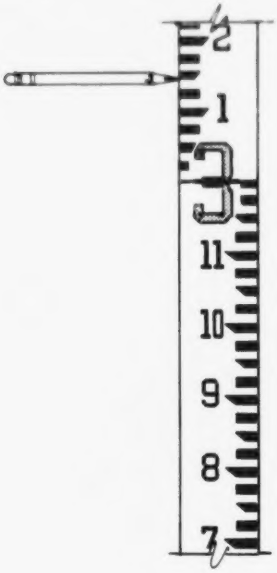
10. Read each of the following illustrations of direct-reading rods to the nearest hundredth or eighth. Write the correct answers in the blanks.



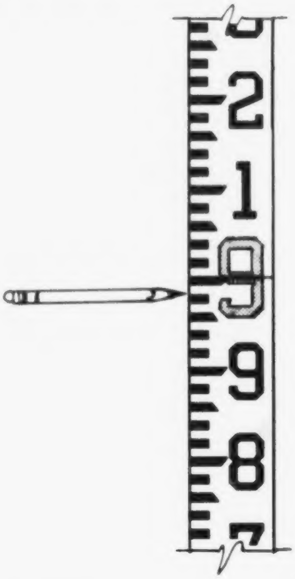
a. ______________________________



b. ______________________________



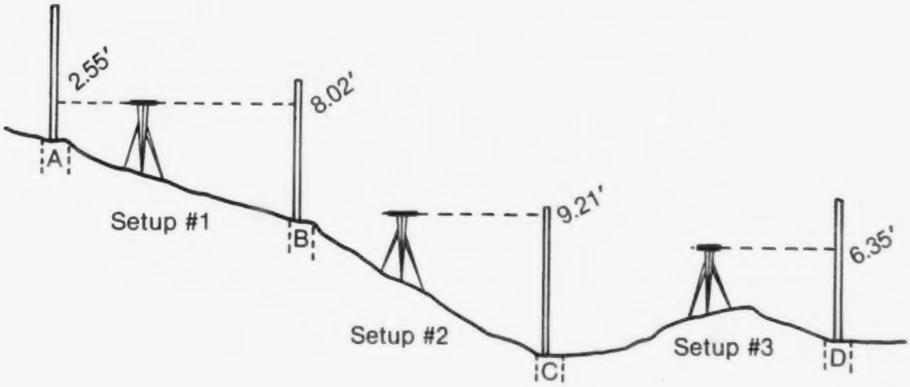
c. ______________________________



d. ______________________________

TEST

11. Calculate the differences in the elevations shown on the illustration below, and then in the blanks provided write the correct differences and "higher" or "lower" as appropriate. Show your work in the space provided at the bottom of the page.

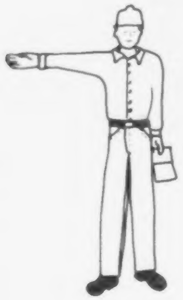


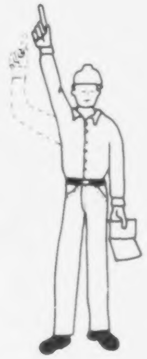
Point	Number of feet	Lower or higher	
a. Point A is	____________	____________	than point B
b. Point B is	____________	____________	than point C
c. Point C is	____________	____________	than point D
d. Point A is	____________	____________	than point C
e. Point D is	____________	____________	than point B

TEST

12. Identify hand signals used by the instrument person to guide the rod person. Write the correct names in the blanks. Some blanks may contain more than one answer. Some answers may be used more than once. Illustrations continue on the next page.

Observation completed
Turning point
Move down
Check clamp
Rod upside down
Move in this direction
Wave rod from side to side
Move on
Understand
Move up
Wrong face
Use long rod
Come in





a. ____________________

____

b. ____________________

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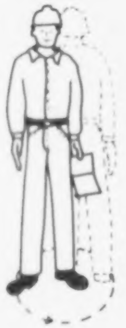
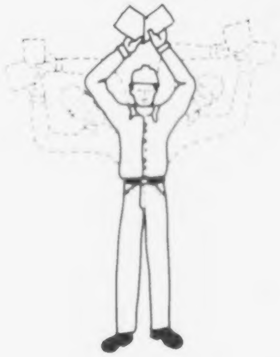




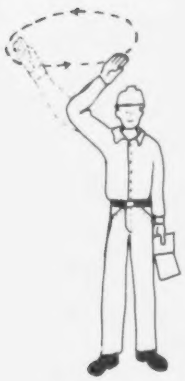
c. ____________________

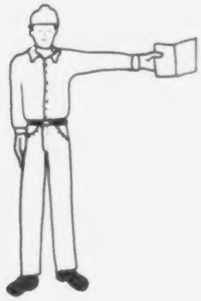
____

d. ____________________

____

TEST





e. ______________________________

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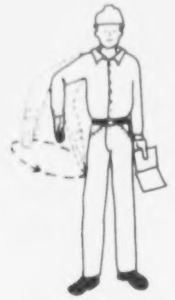
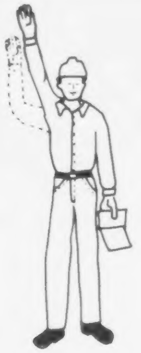
f. ______________________________

____



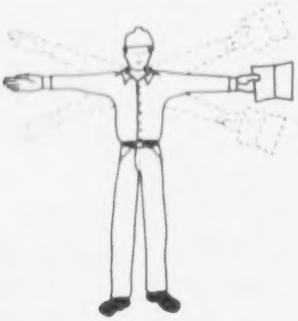


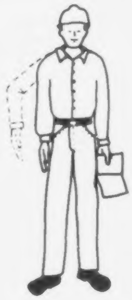
g. ______________________________

____

h. ______________________________

____





i. ______________________________

____

j. ______________________________

____

TEST

(NOTE: Test item 13 lists the job sheets. They are an important part of this test. If they have not been completed, check with your instructor.)

13. Demonstrate the ability to

    a. Set up and adjust a tripod and a builder's level.

    b. Use a builder's level to check footing elevations.

    c. Use a builder's level to perform differential leveling.

    d. Connect plumb bob to an instrument.

    e. Set up and adjust a combination level-transit.

    f. Use a combination level-transit to locate building-line points on batter boards.

LEVELING INSTRUMENTS
UNIT V

ANSWERS TO TEST

1.

	a.	3	f.	1	k.	3	p.	3
	b.	2	g.	2	l.	1	q.	1
	c.	3	h.	3	m.	3	r.	1
	d.	2	i.	1	n.	1		
	e.	1	j.	2	o.	2		

2. Answer should include any two of the following.

   a. Establishing elevations and grades
   b. Establishing differential elevations
   c. Transferring elevations from one point to another

3. a. Engineer's dumpy level
   b. Automatic level
   c. Turret level
   d. Engineer's wild-tilting level
   e. Builder's level
   f. Engineer's Zeiss level
   g. Laser-beam instrument
   h. Combination level-transit

4. a. Eyepiece
   b. Telescope
   c. Focusing screw
   d. Sunshade
   e. Leveling tube
   f. Degree scale
   g. Leveling screws
   h. Head plate
   i. Tripod
   j. Leg thumb-nut
   k. Slow-motion screw
   l. Clamp

5. a. Vertical cross hair
   b. Horizontal cross hair
   c. Line of sight

6. Answer should include any five of the following.

   a. Keep instrument in carrying case when not in use
   b. Protect instrument from shock and vibration when transporting
   c. Remove instrument from carrying case by lifting the level bar
   d. *Never* force screws or other moving parts of the instrument
   e. Place lens and tripod caps in carrying case after removing them from instrument
   f. *Do not* remove lenses
   g. Clean lenses with soft tissue only
   h. Always use sunshade regardless of weather
   i. Loosen leveling screws before returning instrument to carrying case
   j. Carry tripod under your arm with the instrument in front of you
   k. Protect instrument from rain, snow, dust, etc.

ANSWERS TO TEST

7. a. Target
   b. Vernier scale
   c. Rod clamp
   d. Target clamp

8. a. 2 c. 1
   b. 4 d. 3

9. Description should include the following.

   a. Rod graduated in eighths of an inch — Marks indicate feet, inches, and eighths of an inch; each line and each space is one-eighth of an inch thick

   b. Rod graduated in hundredths of a foot — Marks indicate feet, tenths of a foot, and hundredths of a foot; each line and each space is one hundredths of a foot thick

10. a. 2.54′
    b. 6.89′
    c. 3′ – 1$^{3}/_{8}$″
    d. 8.98′

11. a. 5.47′ higher
    b. 1.19′ higher
    c. 2.86′ lower
    d. 6.66′ higher
    e. 1.67′ lower

12. a. Move in this direction
    b. Move up
    c. Wrong face; check clamp; rod upside down
    d. Wave rod from side to side
    e. Turning point
    f. Move in this direction
    g. Come in
    h. Use long rod
    i. Observation completed; move on; understand
    j. Move down

13. Performance skills evaluated to the satisfaction of the instructor.